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*Succulent Flora of
Southern Africa*

Revised Edition



DOREEN COURT

SUCCULENT FLORA OF SOUTHERN AFRICA
REVISED EDITION

This One



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Succulent Flora of Southern Africa

Revised Edition

DOREEN COURT



A.A. BALKEMA / ROTTERDAM / BROOKFIELD / 2000

This book is dedicated to Michael and Jonathan

Cover: *Hoodia pilifera* subsp. *pilifera* (photo by Kobus Venter)

First edition: 1981
Revised edition: 2000

Published by
A.A.Balkema, P.O.Box 1675, 3000 BR Rotterdam, Netherlands
Fax: +31.10.4135947; E-mail: balkema@balkema.nl; Internet site: <http://www.balkema.nl>

A.A.Balkema Publishers, Old Post Road, Brookfield, VT 05036-9704, USA
Fax: 802.276.3837; E-mail: info@ashgate.com

ISBN 90 5809 323 9

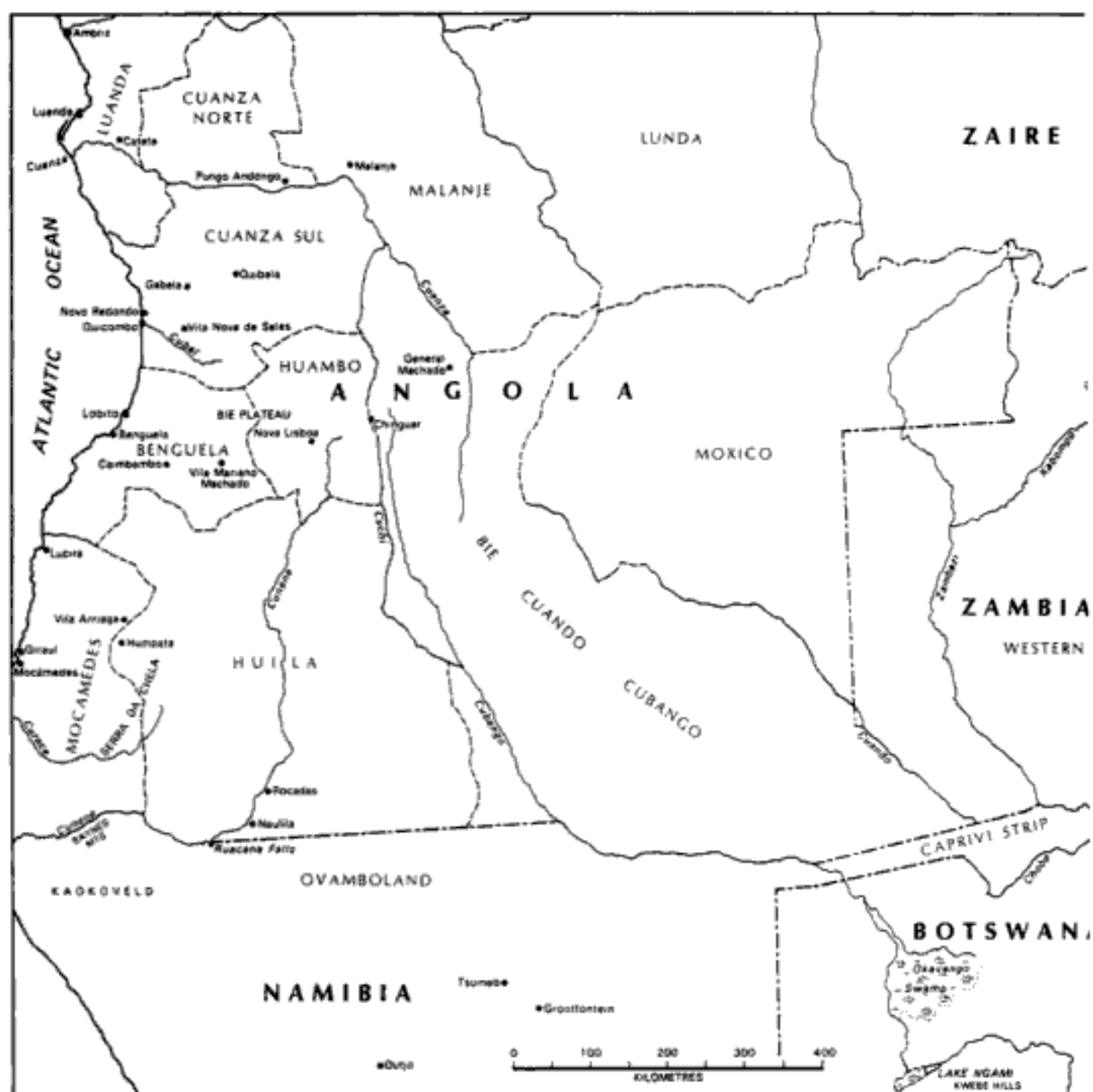
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Printed in the Netherlands

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EAST COAST INSET NOT TO SCALE

0 100 200 300 400
KILOMETRES

Name changes in Zimbabwe:

Gwayi - Gwaai
Gweru - Gwelo
Harare - Salisbury
Hwange - Wankie
Marondera - Marandellas
Masvingo - Fort Victoria

Murewa - Mrewa
Mutare - Umtali
Mutoko - Mtoko
Mvuma - Umvuma
Shurugwi - Selukwe

Preface

During the 1998 IOS Congress at Kirstenbosch, Cape Town, I became aware of the demand for the 1981 *Succulent Flora of southern Africa* which is out of print and out of date. I made an immediate decision to completely revise the 1981 version, and this has taken one and a half years of full-time work. Whereas in writing the first edition priority was given to travelling to find and photograph succulent plants, this time most of the travelling was to university libraries and herbaria to track down hundreds of references, some of the journal entries more than 40 pages in length. I was astounded at the volume of change. On the subject of repeated revision of genera and description of new species it is increasingly felt that all work which involves nomenclatural change should be refereed by one or more taxonomists before it reaches publication.

Authors and references are given in the new edition, and if this deters from what one critic kindly described as an 'easy style of writing' I assure you that there are readers who want this. Today everyone has the tools on his desk which give him instant communication with the world and he is impatient for details. Space does not allow for full synonymy, but recent and relevant synonymy is given. I have, as in the first work, made every effort to put related species together for ease of comparison. The current practice of dispensing with an index and using alphabetical sequence is not in the best interests of the reader who finds related species, which have common and distinguishing characters, scattered throughout the book.

Instead of increasing the generic scope of the book, it has in one instance been reduced: *Welwitschia* has disappeared. It is not a succulent. I have been asked to include *Ceropegia* and have not done so; I apologise to those who wanted it, but then, what of *Fockea*? *Sarcostemma*? In other families, *Pelargonium*, *Senecio*, *Bulbine* and dozens of other genera have succulent members, the list is almost

endless. An exception was made for *Pachypodium*, *Adenium* and *Adenia*, but this book is not a lexicon, it is an account of the major family (in one case, tribal) groups of succulents in southern Africa and is limited by space and cost of production.

South Africa is at present facing changes which involve wider land use. Never before have such great demands been made of her natural resources and this reduces habitat of the remarkable diverse succulent flora found here. Perhaps one answer lies in the establishment of national collections of genera, as is done in England, collections cared for by informed and caring members of the private sector, registered with a central body and run on a non-profit making basis, and made available to those who wish to study them. The few national gardens which have collections at present do not have the funds for so huge an undertaking. The whole thing needs to be opened up, imagine the utility and interest if there was a national collection of *Gibbaeum* in Ladismith in the Little Karoo. Most South Africans know little about succulents; these collections could become an educating asset.

New provincial boundaries in South Africa have made distribution awkward to describe, particularly in the Transvaal, which is now four provinces. The maps show the new boundaries. Overseas readers may find it strange that so many species seem to start, for example, at Beaufort West and end at Graaff-Reinet, that 'regular routes' seem to predominate; in southern Africa towns are far apart, and certain towns are used as 'markers'. The areas which lie between, and beyond, are not necessarily thoroughly searched.

As I write, there is unrest in Zimbabwe, Angola and Mozambique, making botanical exploration hazardous for the time being. Both Namibia and Botswana have a stable atmosphere, and Botswana, in particular, is a country which has not been fully botanically explored. There is no time to be lost.

Acknowledgements

I have been most fortunate in the readiness with which colleagues and friends have extended help to me in the revision of this work. Situated in the Bolland town of Robertson I was hours away from the nearest university and although I made many journeys I needed a helping hand. This was extended to me by Peter Bruyns who generously shared his wide-ranging knowledge of the succulent flora with me and responded immediately when I needed an urgent reference or advice. To him and his wife, Cornelia, a big thank you also for hospitality in their home just below the University of Cape Town. My thanks to Pat Lorber and other staff of the Bolus Herbarium; to Piet Vorster at the University of Stellenbosch for helpful advice and introducing me to their great underground library; to Roy Lubke and staff of my old department of Botany at Rhodes University; to Estelle Brink for always being cheerfully 'at the other end of the line'.

I thank Prof. Gideon Smith, Director Research, National Botanical Institute for permission to use certain illustrations; and Priscilla Burgoyne for her enthusiastic assistance. My thanks to the Curator and staff of the Karoo National Botanic Garden, Worcester, for permission to take photographs and especially Deon Viljoen for his friendly help at all times;

to Bruce Bayer for letting me read his revision of *Haworthia* (in manuscript) and to Kobus Venter for his generous donation of *Haworthia* slides. My contact and helper in Zimbabwe was Dorothy Popiel, in Namibia, Patricia Craven – thank you both, and also to Daphne and Albert Pritchard of Cheshire, England. Nearer home, I wish to thank Buys Wiese of Vanrhynsdorp for sharing his knowledge of that remarkably conserved farm, Quaggaskop, with us, and my son Michael for all the trips into the hinterland in 1999; also Ruth Smart and others of the Ferox Branch (Succ. Soc. of S.A.), Johan Cloete of Calitzdorp and Johan du Toit of George.

A special thank you to Ria Wedgwood who shared her wizardry with computers with me and whose departure from Robertson I still regret. Another special thank you to Mike Kamstra of McGregor for the use of his splendid library of botanical books. Lastly, I thank Anne Tjis Balkema (my publisher) for his patience with my requests, and both he and his wife Gusta for a most enjoyable stay in Holland.

Doreen Court
P.O. Box 36, Robertson 6705, South Africa
April, 2000

Illustration credits

Photographs and sketches are by the author with the exception of the following, for which sincere thanks are extended. In this revised edition 478 coloured illustrations of species are used; 163 of these have been contributed by the people named below:

Peter Bruyns: *Lithops gracilidelineata* subsp. *brandbergensis*, *L. comptonii*; *Portulacaria armiana*, *P. pygmaea*; *Cotyledon campanulata*, *C. tomentosa* subsp. *ladismithiensis*, *C. cuneata*, *C. papillaris*; *Tylecodon elaphiae*, *T. occultans*, *T. pusillus*, *T. sulphureus*, *T. cacalioides*, *T. paniculatus*; *Adromischus phillipsiae*; *Crassula expansa*, *C. corallina*, *C. simulans*, *C. peploides*, *C. ericoides*, *C. montana*, *C. columnaris*, *C. barklyi*, *C. alpestris*, *C. alstonii*, *C. ausensis*, *C. ausensis* subsp. *giessii*, *C. susannae*, *C. mesembryanthemopsis*, *C. grisea*, *C. cultrata*, *C. nudicaulis* var. *herrei*; *Euphorbia quadrata*, *E. suffulta*, *E. stapelioides*, *E. herrei*, *E. juttae*, *E. celata*, *E. monteiri* subsp. *brandbergensis*, *E. eustacei* (2), *E. restituta*, *E. multifolia*, *E. friedrichiae*, *E. wilmaniae*, *E. waterbergensis*, *E. grandilata*; *Adenia pechuëlli*; *Aloe chlorantha*, *A. corallina*, *A. viridiflora*.

Priscilla Burgoyne: *Skiatophytum tripolium*; *Gibbaeum pubescens*; *Mestoklema tuberosum*, *M. arboriforme*; *Delosperma deilanthoides*, *D. sutherlandii*; *Oscularia lunata*; *Trichodiadema intonsum*; *Chasmatophyllum musculinum*; *Rhinephyllum graniforme*; *Frithia pulchra*, *F. humilis*; *Nananthus margaritifera*; *Tanquana prismatica*; *Hammeria meleagris*; *Lapidaria margaretae*; *Dracophilus proximus*; *Ebracteola wilmaniae*; *Khadia alticola*; *Argyrodema congregatum*; *Vanzijlia annulata*, *Aloe mitrifolmis*.

Peter Craig: *Euphorbia bupleurifolia* (2).

Dr N. Jurgens: *Euphorbia ramiglans*. Curator, Karoo Botanic Garden, Worcester: *Quaqua linearis*, *Q. arenicola* subsp. *arenicola*, *Q. incarnata* subsp. *incarnata*, *Q. parviflora*; *Ophionea arcuata* subsp. *mirkinii*; *Tavarestia barklyi*; *Tridentea peculiaris*, *T. parvipuncta* subsp. *parvipuncta*; *Orbea ciliata*; *Orbeopsis melanantha*, *O. caudata*; *Pachycymbium rogersii*, *P. lugardii*; *Stape-*

lia engleriana, *S. clavicorona*, *S. vetula*, *S. hirsuta*; *Tromotriche longii*, *T. herrei*, *T. longipes*, *T. umdausensis*.

Cornelia Klak: *Caulipsolon rapaceum*; *Brownanthus glareicolus*; *Psilocaulon dinteri*.

Gerhard Marx: *Aloe pictifolia*.

Johan Meyer: *Aloe africana*; *Haworthia variegata* with *Gasteria carinata*; *Antimima evoluta*, *Phyllobolus* sp.

Pauline Petry: *Euphorbia venenata*, *E. ingens*, *E. multiceps*; *Stapelia gigantea*; *Orbea namaquensis*.

Daphne Pritchard: *Monadenium mafingense*, *Pleiospilos bolusii*, *P. compactus*.

Dave Richards: *Euphorbia rugosiflora*, *Adenia karibaensis*.

Kobus Venter: *Aloe cryptopoda*, *A. brevifolia*, *A. pillansii*, *A. dichotoma*, *A. pratensis*, *A. krapohlana*, *A. krapohlana* var. *diomoulinii*, *A. ferox*, *A. melanacantha*, *A. marlothii*, *A. asperifolia*, *A. lineata*, *A. bowiea*, *A. pearsonii*, *A. khamiesensis*; *Gasteria pillansii* var. *ernestii-ruschii*, *G. glomerata*; *Dorotheanthus rowkei*; *Euphorbia mira*, *E. obesa* subsp. *symmetrica*, *E. meloformis* subsp. *valida*, *E. horrida*; *Hoodia pilifera* subsp. *pilifera*; *Pachypodium succulentum*; *Astroloba spiralis*; *Haworthia herbacea*, *H. magnifica*, *H. magnifica* var. *splendens*, *H. mirabilis* var. *mirabilis*, *H. mirabilis* var. *paradoxa*, *H. mirabilis* var. *badia*, *H. retusa*, *H. emelyae*, *H. arachnoidea* var. *aranea*, *H. arachnoidea* var. *setata*, *H. arachnoidea* var. *scabrispina*, *H. mucronata* var. *morrisiae*, *H. nortieri* var. *pehlemanniae*, *H. cooperi* var. *pilifera*, *H. cymbiformis*, *H. variegata*, *H. outeniquensis*, *H. blackburniae*, *H. scabra* var. *starkiana*, *H. scabra* var. *morrisiae*, *H. longiana*, *H. reinwardtii*, *H. viscosa*, *H. marginata*, *H. kingiana*.

Piet Vorster: *Aloe pretoriensis*.

MONOCHROMES

The author thanks Prof. Gideon Smith (NBI, Pretoria) for the use of the sketch of *Chortolirion angolense* by Gillian Condy. Loaned monochrome material was fully acknowledged in the first edition; in particular the author thanks Piet Vorster for photographs of *Pachypodium* (4), *Euphorbia* (1), *Hoodia* (2) and *Gasteria* (1), and Bruce Bayer for his line drawings of the mesem capsules.

Mesembryanthemaceae

Veld vygies or fig marigolds

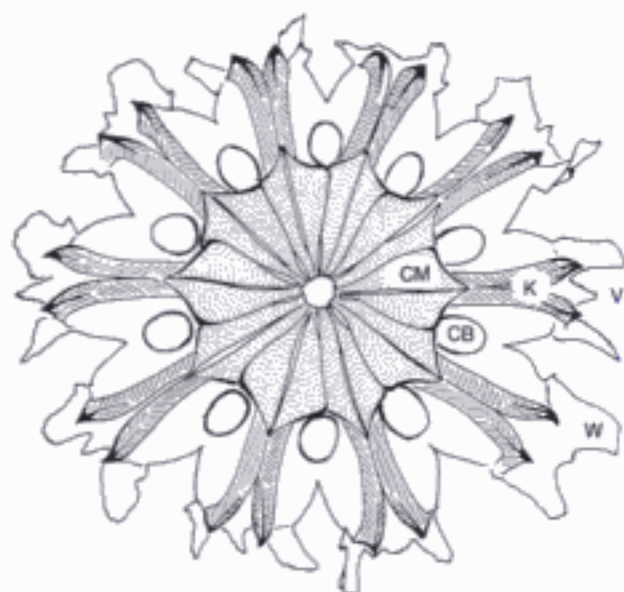
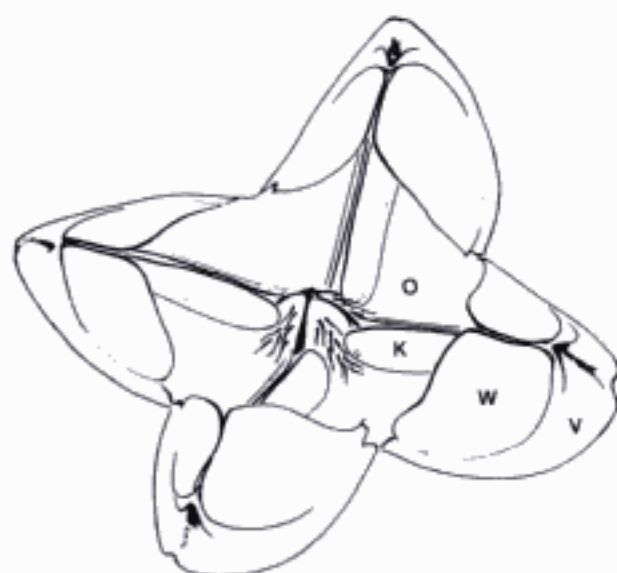
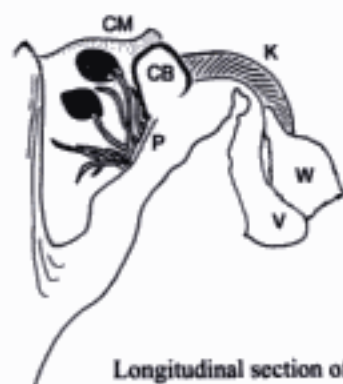
The name *Mesembryanthemum* was first coined by Jacob Breyne in 1689 to convey the meaning 'noon-flowering' from the Greek 'mesembria' meaning midday; it was adopted by Linnaeus when he founded the genus which was to become a temporary repository for a great many species. From the early 1920s, the splitting of *Mesembryanthemum* was rapidly carried out by N.E. Brown (Chief Assistant in the herbarium at Kew), G. Schwantes (in Hamburg and Kiel) and L. Bolus (Bolos Herbarium, Cape Town) accompanied by the description of a great many new species. Dr L. Bolus alone described 1445 species, with the object of providing a broad basis for future work on the analysis of genera, sections and species.

Research was, and still is, in the hands of the German botanists. It is not easy to explain the German fascination for the Southern African succulent plants, the mesems in particular. It is obviously connected to the German involvement with Namibia, which was a German Protectorate from 1880 to 1915, but this can only be part of the story. One cannot list all the early German researchers here, except for Hans Herre who left Germany in 1925 to take up his post as curator of the Botanical Garden at the new University of Stellenbosch. His work *The Genera of the Mesembryanthemaceae* (1971) has been a main source of mesem information for many years. The seat of German research of the mesems is at the Institute of General Botany at the University of Hamburg. Active in this field and presently the leader of it, is Dr Heidrun E.K. Hartmann, who has produced an enormous amount of published research related to extensive field work in South Africa. She has collected thousands of mesem specimens, all of which have been analysed for 220 characters. She recognises two subfamilies in Mesembryanthemaceae and has produced keys to the genera. In 1991 Hartmann recognised 116 genera with about 2500 species. Of course these

numbers change as research proceeds. Instead of a rigid classification Hartmann prefers to place the genera into tentative groups which have common characters, thus forming a base for further research. Her system of grouping is used in the following account in which 121 genera are described with their distribution.

Two major monographs have appeared: Desmond Cole's *Lithops – Flowering Stones* (1988) and Steven Hammer's *The Genus Conophytum* (1993). Apart from revisionary work by H. Glen, isolated papers and the publication of some new species there has been little organised research on the mesems by South African botanists since the days of Prof. G.C. Nel (*Lithops* and *Gibbaeum*) and H. Herre at Stellenbosch University. In recent years a more positive approach has been taken and the curators of the mesem collections at the National Herbarium in Pretoria and at the Bolus Herbarium, University of Cape Town are actively involved in research. The revision of *Psilocaulon* by C. Klak (curator of the Bolus mesem collection) and H.P. Linder is a case in point.

The classification and keys produced from the 1920s onwards relied largely on the structure of the fruit. The fruit of the *Mesembryanthema* will not lose its fascination as a complex mechanism designed for the survival of the species in a hostile environment. It consists of several to many compartments (loculi) in which the attachment of the seeds is either parietal (along the side walls) or axile (at the centre). By unequal shrinkage of dead cells in the fruit wall the valves of the capsule open out on wetting and close on drying (hygrochastic), or open on wetting and remain open on drying (hygroscopic) or open on drying (dry-dehiscent). Ihlenfeldt maintains that at least 98% of mesems have a loculicidal hygrochastic capsule. The seeds are flung out of the open capsule by raindrops. In the, apparently, primitive capsules, the seeds are

Advanced type capsule of *Leipoldtia* sp.Primitive type capsule of *Aridaria* sp.Longitudinal section of *Leipoldtia* capsule with parietal placentation of ovules

- K = expanding keel
- P = placenta
- CM = covering membrane
- CB = closing body
- O = loculus without covering membrane
- V = valve
- W = valve-wing

Longitudinal section of *Aridaria* capsule with axile placentation of ovules

exposed and are quickly dispersed by rain, while in the complex types, the loculi have covering membranes, and in some cases, placental outgrowths called tubercles, (currently called closing bodies) which hinder the expulsion of the seed and thus extend the period of dispersal, allowing for the possibility of better germination conditions at a later time. This adaptation is taken further in some species by the development of seed pockets inside the loculi, in which the seeds are trapped until the surrounding tissue disintegrates, by which time the seeds may be able to germinate and take over the possibly favourable spot which the parent plant had occupied. According to Ihlenfeldt, the seeds are irregular in germination and, in those species investigated, there appear to be two germination 'peaks' separated by a period when the germination rate is low. By extending the period of seed dispersal and germination the species equips itself for all the

vagaries of the weather in dry regions.

If the reader wants a full account of the intricate structure and mechanism of the mesem capsule he is advised to read 'Some aspects of the Biology of Dissemination of the Mesembryanthemaceae' by Prof. Dr H.-D. Ihlenfeldt in *The Genera of the Mesembryanthemaceae* by H. Herre (1971).

The distribution of the family Mesembryanthemaceae is largely restricted to the dry, western regions of southern Africa with winter rainfall, with less than one-fifth of the genera possessing a south-easterly location, or, much more rarely, extending northwards.

According to Hartmann the Mesembryanthema form a monophyletic branch in the family Aizoaceae; if this branch is looked upon as a separate family its name is Mesembryanthemaceae. Two subfamilies are recognised:

1. Mesembryanthemoideae in which the nec-



Mesembryanthemum guerichianum

taries are shell-shaped and separate; there is axile placentation of the ovules and the fruit if not hygrochastic is a woody nut. A small group of 11 genera, mainly in southern Africa, widely introduced into other countries, or escaped.

2. Ruschioideae in which the nectaries are crest-shaped, separate or in a ring, rarely absent, parietal to basal placentation of the ovules, the fruit if not hygrochastic, xerochastic or breaking into mericarps. A large group of 107 (or more) genera, mainly in southern Africa, also on other continents, particularly on their coastlines, natural distribution outside southern Africa uncertain.

1 SUBFAMILY MESEMBRYANTHEMOIDEAE

Annual to perennial herbs, shrublets or shrubs, woody or succulent. Leaves shedding or persistent, sometimes very large, often with bladder cells, the capsule 4-5 locular, seed dispersal by rain splash mechanism. At the time of writing 13 genera form this subfamily: *Aptenia*, *Platythera*, *Mesembryanthemum*, *Eurystigma*, *Synaptophyllum*, *Prenia*, *Sceletium*, *Aridaria*, *Phyllobolus*, *Psilocaulon*, *Caulipsolon*, *Brownanthus* and *Aspazoma*.

Aptenia N.E.Br. [colour p. 37]: A vigorous, prostrate 'cover' plant which grows easily from cut

tings. *A. cordifolia* occurs in the coastal region of the Eastern Cape and, surprisingly, at Leeupan in the Kruger National Park in the eastern Transvaal; it has flat, heart-shaped, fleshy leaves and bright, glossy, purplish-red flowers. A second species, *A. lancifolia*, has lanceolate leaves and magenta flowers and occurs at Bandelierkop in the Northern Province. The valves of the 4-locular capsule are wingless and covering membranes are missing. The small genus **Platythera** which was published at the same time by N.E. Brown in 1925 is closely related. It is a monotypic genus of the Eastern Cape which, like *Aptenia*, has a prostrate habit. *P. haeckeliana* has triangular or quadrangular stems with distinct nodes which give the older stems a jointed appearance. The pale yellow flowers are borne in the axils of the leaves; conspicuous in the young fruit are the sepals of which one opposite pair is broad and leafy, the other narrow and spike-like. As in *Aptenia*, the capsule lacks covering membranes and closing bodies, but differs in that the valves are winged.

Mesembryanthemum L. [colour p. 37]: From the Greek word 'mesembria' meaning 'midday' and 'anthemon' meaning flower, as the flowers open at noon. The name originated with Jacob Breyne of Antwerpen; in 1680 Linnaeus took over this name and for a very long while all mesems were placed

in this genus. The genus covers a tremendous range of arid territory in the Western and Northern Cape, Namibia and southern Angola, and proceeds eastwards through the karoo to the Eastern Cape. Jacobsen (*Lexicon* 1970) listed 47 species. The trend from 1970 has been the sinking of several monotypic and small allied genera under *Mesembryanthemum* accompanied by a great reduction in the number of species. Although variable, this genus is not difficult to recognise: prostrate or erect, rather ragged-looking plants, often large-leaved and always dewy with large glistening papillae. The flowers are white, red, pink or yellow, petals slender, capsule of 5 (rarely 4) locules, without covering membranes or closing bodies, the valves have inflexed or erect wings. No better description can be found than that of Dinter in describing his species, the closely related *Halenbergia hypertrophica*: 'like linen spread out to bleach on the yellow patches of desert scree near Halenberg' (Namibia). *Hydrodea sarcocalycantha* is a branching, procumbent halophyte which occurs in coastal desert and salt pans in Namibia and is also recorded from St. Helena. The plants form mats up to 1 m wide and 200 mm tall. The juicy, finger-like leaves are green, yellow or red, the latter giving rise to the name 'blutige finger' in Lüderitz. Both the last-named genera and *Opophytum* were published as synonyms of *Mesembryanthemum* by Friedrich in *Prodr. Fl. S.W. Afr.* 27. *Eurystigma clavatum* L. Bolus makes an unforgettable sight in the Ceres Karoo, painting the entire terrain yellow, the club-shaped pedicels ending in flattened 'shaving brushes' at noon.

Synaptophyllum N.E.Br. ('gnarled leaf'): The single species, *S. juttae*, occurs from the Orange River near Sendelingsdrift northwards to Lüderitz, a coastal area which has the benefit of Atlantic fog. A small, branching, prostrate annual in reddish or purple tones, characterised by the very large lower leaf-pairs always immediately below the upper smaller leaf-pairs. The stem pierces the fused pair of flat, papillose, roundish-ovate leaves; the small flowers are pure white (6-7 mm in diameter); the capsule has 4 locules without covering membranes or closing bodies, and possesses valves with large, erect wings.

Prenia N.E.Br.: Present widely in Eastern, Western and Northern Cape Provinces, and southern Namibia. Creeping or erect, these are pioneer plants which are common on disturbed ground such as

found along roads and airstrips. The waxy, papillate leaves may tuft centrally, the plant producing flowering branches up to 400 mm long. Flowers are white, pink purple or yellow and appear from spring to autumn. *P. sladeniana* from the Richtersveld has firm stems, the leaves broad and flat with red margins. *P. pallens* is a common roadside weed in the Western Cape. The genus was revised by Gerbaulet in 1996 (*Bot. Jahrb.* 118) and six species are recognised.

Sceletium N.E.Br. [colour p. 37]: An interesting genus of the dry Western and Eastern Cape Provinces. Recently revised (Gerbaulet 1996) the number of species has been reduced from 22 to 8. The name, meaning 'skeleton', refers to the persistent, dry, skeletonised leaves which afford some protection to the younger green leaves. The plants are short-stemmed undershrubs which develop short or long spreading branches; the terminal flowers are white to yellowish. Herre states that the Hottentots collected *Sceletium* which contains the poison 'mesembrine', and packed it into jars to ferment, later using it dried as a substitute for 'chew' tobacco.

Aridaria N.E.Br.: As the name suggests, this genus occurs widely over the most arid regions of Namibia, western and northern Cape and along the southern Karoo eastwards to Pearston. *Aridaria* species are woody with a stout taproot, erect or prostrate, the sessile leaves terete or nearly so, easily deciduous and up to 40 mm long. The flowers are white, yellow, pink or red, often opening in the evening and scented. In the past the genus was considered a very large one, until Friedrich in 1967 placed 22 species in synonymy with the type species, *A. noctiflora*. The latter is a twiggly shrub from 500-800 mm tall with sweet-scented white flowers which open at night. The genus was revised by Gerbaulet in 1996 (*Bot. Jahrb.* 118) and reduced to four species: *A. noctiflora* with three subspecies to take up its variation; *A. brevicarpa* which is erect to 1 m, with brownish-yellow flowers which open during the day; *A. serotina* a prostrate with bluish-green leaves, glossy at first, flowers purplish-red; and *A. vespertina* which is small, erect to 150 mm, woody, flowers pale pink, coppery-red on the reverse, opening in the evening.

Phyllobolus N.E.Br. [colour p. 37] (*Amoebophyllum*, *Dactyloopsis*, *Sphalmanthus*): Much the same arid distribution area as for *Aridaria*: southern Namibia and Western, Eastern and Northern Cape

Provinces. Gerbaulet reassessed the generic boundaries of *Phyllobolus* in 1995 and revised the genus in 1997 (*Bot. Jahrb.* 117 and 119). At the present time *Phyllobolus* consists of 32 species, and describes erect or creeping shrubs with, often, a tuberous rootstock, corky or woody stems, water cells (papillae) on stems and all green parts, capsule 4-5 locular, with relatively large, rough seeds. Leaves may be deciduous (falling off) or marcescent (drying out and remaining attached). *Sphalmanthus* has strong affinities here, having a papillose character of herbaceous parts, and this is also typical of the genus *Amoebophyllum*. Herre referred to the papillae of the latter as 'glittering warts'. The well known *Dactyloopsis* which occurs in the Vanrhynsdorp and Vredendal districts in Namaqualand stands further away from the rest, being very dwarf, clump-forming, the fat terete leaf completely ensheathing the next leaf and the stem, withering down completely when at rest, having no obvious water cells on the leaves and its seeds atypical. In Herre's words 'the petaloid staminodes are, in contrast to all other genera, dry and stiff'. According to Gerbaulet the leaf bladder cells are flattened and appear absent; and that in spite of its 'peculiar autapomorphic features', characters in growth form, leaf arrangement and flower morphology are shared with *Phyllobolus*. This is a controversial decision as others working in the mesem field do not agree that *Dactyloopsis digitata* belongs in the *Phyllobolus* complex. The small, white terminal flowers of *Phyllobolus digitatus* remain open day and night for up to three weeks; there are two subspecies: *P. digitatus* subsp. *digitatus* is a bigger plant, (up to 200 mm tall) while *P. digitatus* subsp. *littlewoodii* is smaller, its long leaf 30-50 mm long, it is found at the northern end of the range, east of Bitterfontein.

Psilocaulon N.E.Br. [colour p. 37]: The name means 'bare stem'. The species occurs widely from Angola through western and southern Namibia to western, central and southern South Africa. Previously a very large genus, the number of species is much diminished, partly because *Brownanthus* Schwantes is again recognised. *Psilocaulon* was revised by Klak & Linder (*Bot. Jahrb.* 120, 1998); 13 species are recognised. *P. rapaceum* Jacq. is excluded from the genus and a new genus, *Caulipsolon* Klak, set up for it. The annual *P. granulicaule* grows mainly outside the winter rainfall areas in the Northern, Western and Eastern Cape Provinces, but is also recorded from several widely separate

areas in Namibia, and in Australia, into which it was almost certainly introduced. The genus, which is annual or perennial, creeping or erect, is variously described as having articulated, jointed or beaded stems. The leaves are sessile, opposite, 3-28 mm in length, shedding or drying up as soon as conditions become dry, but unlike *Amoebophyllum* (now under *Phyllobolus*) do not become spinescent. Leaves and stems have a layer of wax, and idioblasts (bladder cells) are present, these may be flattened, dome-shaped or even hair-like and readily apparent as in *P. articulatum*. The small flowers are usually white, less often pink and rarely yellow, solitary or clustered at the tips of the stems. The filamentous staminodes are transparent and form a conspicuous cone. The capsules have 4 or 5 deep locules and the valve wings inflex over the valves.

Caulipsolon Klak [colour p. 37] (*Psilocaulon rapaceum*, *P. longipes*): On disturbed ground in southern Namaqualand. *Caulipsolon rapaceum* (Jacq.) Klak was previously a member of the *Psilocaulon* genus, but presents a combination of characters which, according to its author, exclude it from the other genera of Mesembryanthemoideae. *Caulipsolon* has a tuberous rootstock which produces annual, prostrate, aerial, articulated stems which later break off and disappear, being replaced in the next growth season. The succulent leaves 11-38 mm long are almost terete and smooth, with bladder cells flattened. Flowers are white, 20-30 mm across, solitary or several together per stem, making the plants conspicuous from June to September. The new genus differs from *Psilocaulon* in having a geophytic life form, with deciduous branches, the flowers have petaloid staminodes but lack filamentous staminodes, and the capsule has reflexed valve wings which are fused in pairs.

Brownanthus Schwantes [colour p. 37] (*Pseudobrownanthus*): Extends from Angola along the western length of Namibia and covers the western half of the Northern Cape, extending into the Western Cape. This genus was set up in 1927 and was sunk under *Psilocaulon* by Friedrich in 1970. It was set up again in 1985 by Ihlenfeldt & Bittrich, taking part of the original *Psilocaulon* with it. Ten species are recognised, most of them old, three of them of recent description. Pierce & Gerbaulet (*Aloe* 34, 1997) distinguish between *Brownanthus* and the closely allied *Psilocaulon*. Both genera are small shrubs with green articulated stems and terete to trigonous leaves. Apparently one can distinguish

Brownanthus from its ally by examining (with a hand lens) the shape of the toughened bladder (water) cells which are well defined in longitudinal rows in *Brownanthus*, and often flattened, not toughened, and ill-defined in *Psilocaulon*. *Brownanthus* lacks the filamentous staminodes present in *Psilocaulon*; also the calyx lobes of *Brownanthus* remain erect during flowering, not spreading as in *Psilocaulon*. *Brownanthus* in some species, produces a fringe of 'hairs' around the stem nodes, in one species a 'papery skirt'. Two new species include *B. neglectus* Pierce & Gerbaulet, a bushy plant up to 400 mm, in which the staminodes are white and petaloid, not filamentous, the calyx 4-lobed and erect, flowering August-October. It occurs in northern Richtersveld and southern Namibia. The other, *B. pseudoschlichtianus* Pierce & Gerbaulet, occurs in much the same region, is also shrubby, to 700 mm. Both species are similar to *B. arenosus*. In the same report, the authors sink the relatively new, monotypic genus, *Pseudobrownanthus* Ihlenf. & Bittrich under *Brownanthus*, which gives the lone species a new combination: *B. nucifer* (Ihlenfeldt & Bittrich) Pierce & Gerbaulet. Its previous separate status was based on its possession of a nut-like fruit and not a hygrochastic capsule.

Aspazoma N.E.Br.: Present in the Richtersveld and further south in Namaqualand. A small, monotypic bushy perennial up to 150 mm tall. The young stems of *A. amplexans* are green and jointed, becoming woody, with elevated branching habit. The finely pubescent leaves have a tubular sheath which clasps the stem, on falling they expose the shortly jointed stem. The flowers are large, up to 40 mm across, solitary at the end of the stem, pale yellow or white, with filamentous staminodes. The capsule has 4 or 5 locules, the seeds large and light yellow.

2 SUBFAMILY RUSCHIOIDEAE

Compact to shrubby habit; usually perennial, rarely annual; leaves mostly opposite, often joined; locules 4 to many; at the time of writing 108 genera which are mainly in southern Africa, most often in areas of winter rainfall of less than 200 mm annually.

In 1991 Hartmann arranged the genera of this subfamily in eleven groups; this system is followed here.

2.1 *Apatesia* Group

The genera in this group have much in common: they are annual or at least short-lived, have low speciation in mostly the same area (south-western Cape), have flat (rarely terete) leaves, yellow (rarely white) flowers on long pedicels, and the capsules exhibit reduction of expanding tissue, breaking into mericarps, with seed pockets often present.

Apatesia, *Carpanthea*, *Conicosia* and *Hymenogyne* form a monophyletic group that is apparently distinct from the rest of the Mesembryanthemaceae on the basis of capsular features. The other genera, *Caryotophora*, *Saphesia* and *Skatophytum* which are included here represent a branch within the Ruschioideae. Refer to Ihlenfeldt, H.-D. & Gerbaulet, M. in *Bot. Jahrb.* 111 (1990).

Apatesia N.E.Br.: Distributed from Cape Town to Vanrhynsdorp in the Western Cape. There are three species, all annual with flat petiolate leaves and decumbent branches. The flowers are solitary, erect on long pedicels, the petals and the centre of the flower being clear yellow. Expanding keels are present in the capsule, but not all of the seeds develop in the locules, a few develop in true seed pockets. (This mechanism delays dispersal and thereby extends the period over which possible germination can take place.)

Carpanthea N.E.Br.: Coastal in the extreme south-western corner of the Western Cape. This is a monotypic annual succulent plant with most parts covered with white hairs; it is found on sandveld and in coastal fynbos vegetation. Large yellow flowers have long pedicels and open in the afternoon; the sepals are unequal in size and shape. The single species, *C. pomeridiana*, tolerates some shade and prefers winter rainfall. In this group which shows progressive development towards true seed pockets in the fruit and reduction of expanding tissue, *Carpanthea* has seed pockets but their openings are large enough for the seeds to escape; these are not true seed pockets.

Conicosia N.E.Br. (*Herrea* Schwantes): Western and Northern Cape Provinces, also southern Namibia. The name, meaning cone-shaped, refers to the capsule. Perennial or biennial, with fibrous roots or a tuberous rootstock; leaves trigonous or terete, 150-200 mm long, crowded in a basal tuft or tufted at the end of a trailing or erect stem. The prostrate branches often dry up annually. Flowers

solitary, yellow, very large, on long pedicels and with an unpleasant odour; sepals broad-based with long terete downward-directed ends. The large capsule is a schizocarp with 10-25 locules, separating when dry to release the free seeds. There is no expanding tissue and true seed pockets are present. Spring-flowering, opening in the afternoon. There are two species, *C. elongata* and *C. pugioniformis*. The latter has two subspecies, one of which, subsp. *muirii*, occupies a coastal belt from Riversdale to Knysna.

Hymenogyne Haw.: Two species extend from the Cape Peninsula to Vandrinsdorp in the Western Cape. Annual flat-leaved herbs with prostrate branches. The solitary flowers have long erect pedicels, which bend under the weight of the large fruit into a prostrate position. Appearing from spring to summer, the flowers are yellow, fading to orange, opening in the afternoon. In *H. glabra* which is at the south end of the range, the ovary extends into a funnel-shape, with 9-12 papillae-like stigmas on the rim. The fruit is a schizocarp, and does not respond to moisture; free seeds are not seen as they lie in seed pockets. The fruit separates into large, one-seeded winged structures which are flat and wind dispersed. In *H. conica* which has the northerly distribution the distal ovary extension is conical.

Caryotophora Leistner: The name means 'nut-bearing'. It occurs near Cape Agulhas in the south-western Cape. Described in 1958, this perennial genus is only slightly succulent and found on sandy soils where it suckers freely. The only species, *C. skiatophytoides*, has a short main stem bearing flat, narrow leaves 60-160 mm long, stem-clasping at the base, and producing annual flowering branches on which the leaves are much shorter. The white flowers are terminal and 40-60 mm in diameter. The fruit is a schizocarp which separates into 3 or 4 woody mericarps which are bilocular, with one seed in each locule. Seed production is therefore very low, and probably accounts for the localised occurrence of the species. The plant resembles the genus *Skatophytum*, which also has a south-western location, but the latter has a 5-locular, dry-opening capsule.

Saphesia N.E.Br.: From Malmesbury to Piquetberg in the Western Cape but rare and threatened. It is a low-growing, woody-stemmed shrublet which takes its name from the Greek 'saphes' meaning 'different from the rest'. The genus is monotypic,

the specific name of *S. flaccida* describes the long, flat, limp leaves (50 mm long, 80 mm broad) which dry off during summer. At one time, the species was present on the sand flats near Cape Town but, together with that of large stretches of natural vegetation, its habitat has been destroyed by exotic *Acacia* species introduced from Australia in the 1870s to stabilise the sand dunes. The flowers are long-stalked and white, the 5-locular capsule is dry-dehiscent and differs from all other capsules in the *Mesembryanthema* group.

Skatophytum L.Bolus [colour p. 37]: Around Cape Town where it is threatened by urban development and northwards towards Clanwilliam. The name means 'shade plant' indicating its preferred habitat. Annual or biennial, producing long trailing stems, the leaves flat, spatulate-lanceolate, smooth and shiny, somewhat fleshy, with reddish uneven margins. The white flowers are about 30 mm across, 2 to 5 in a terminal cyme with pedicels up to 60 mm, flowering in spring and opening in the afternoon. The fruit is 5-angular below the unequal sepals, and 5-locular, expanding keels absent and therefore not responding to moisture, but opens when dry and remains open. The only species, *S. tripolium*, can be mistaken for the white-flowered *Caryotophora skiatophytoides* when it is not in fruit. The fruits are larger and softer than the hard nut-like fruits of the latter species.

2.2 Cleretum Group

Annual plants with flat leaves and prominent bladder cells. Capsules with or without covering membranes, expanding sheets predominant. The *Cleretum* Group represents the revised subtribe *Dorotheanthinae* in the Schwantes classification and includes the genera *Cleretum* (= *Micropterum*), *Aethephyllum* and *Dorotheanthus* (= *Pherelobus*). Refer to Ihlenfeldt, H.-D. & Struck, M. in *Beitrage zur Biol. der Pflanzen* 61: 411-453 (1986). Annual plants with flat leaves and prominent bladder cells. Capsules with or without covering membranes, expanding sheets predominant.

Cleretum N.E.Br. (*Micropterum*): From Richtersveld through Namaqualand to the Western Cape, often on disturbed soil. A flat growing annual herb covered with glistening papillae. The leaves are opposite, lanceolate or spatulate, entire or pinnatifid (margins lobed). The flowers are small, in which

case they are cleistogamous, or large and pollinated in the normal way. The capsule is 5-locular, the expanding keels are parallel with large valve wings, covering membranes are reduced or absent. There are three species: *C. herrei* is only found on the Cape Peninsula; *C. lyratifolium* Ihlenf. & Struck is a karoid species near Matjiesfontein. Both of these have white flowers. The old species, *C. papulosum*, has yellow flowers and a wide distribution, also yellow-flowered is its subsp. *schlechteri* which is distinguished by its flowers which have longer pedicels.

Aethephyllum N.E.Br.: From the south-western Cape to Vanrhynsdorp in the Western Cape. The name means 'irregular leaf'. A prostrate annual plant with glistening papillae, the leaves flat and pinnatifid (deeply lobed along its length) which character gives the single species its name: *A. pinnatifidum*. The small yellow flowers have few stamens which are not always completely developed; this may indicate self fertility. The capsule is 5-locular with large expanding sheets; covering membranes are reduced.

Dorotheanthus Schwantes [colour p. 37] (*Pherelobus*): South-western Cape and Namaqualand. The seven species of *Dorotheanthus* include the most beautiful of the annual mesems. Schwantes named the genus after his mother, Dorothea. The plants are low-growing, spreading, usually under 100 mm in height, the narrow, tapering or spatulate leaves glisten with papillae. The flowers are up to 40 mm across on pedicels up to 60 mm. The capsule is 5-locular and variable. With the exception of *D. apetalus*, which has a few petals (but a ruby-red ovary) the others have many showy petals in a great variety of brilliant colours. The favourite is *D. bellidiformis* subsp. *bellidiformis*, the 'Bokbaai vygie' which is planted in autumn and produces a multi-coloured carpet of flowers; subsp. *hestermalensis* is distinguished by its small size and small pink flowers. *D. maughanii* (*Pherelobus maughanii*) has white or yellow flowers, its stamens and 5 distinctive lobes on the ovary are dark red. *D. booyseii* is similar with white flowers and red anthers at the centre. *D. gramineus* is easily separated by its linear leaves, and the unusual *D. rourkei* has unmistakable red petals which taper to a sharp point. In 1996 a new species, *D. ulularis* Brusse was described from the southern Cape coast, similar to the Bokbaai vygie but with narrower leaves.

2.3 Mitrophyllum Group

Two usually dimorphic leaf-pairs per growth season, sometimes anisophyllous (unequal in the same pair) with prominent bladder cells. Ring-like nectary, covering membranes present or reduced, expanding tissues merging to form one body, spongy closing sills or bodies present or absent, broad valve wings.

To assist in identification the genera are listed according to their habit:

- Dwarf: *Diplosoma* (= *Maughaniella*) and *Oophytum*.

- Low-growing, clump- or mat-forming: *Disphyma*, *Glottiphyllum* and *Drosanthemopsis*.

- Shrubby, with or without dimorphic leaves: *Dicrocaulon*, *Jacobsenia*, *Mitrophyllum*, *Monilaria* and *Meyerophytum*.

Diplosoma Schwantes (*Maughaniella*): Knersvlakte in Namaqualand and Piquetberg in the south-western Cape. The name which means 'double body' refers to the annual pair of pulpy, blistered leaves produced by the plant which is solitary or clump-forming. The flowers appear in spring, opening in the afternoon. The capsule has 5-7 locules and no closing bodies. There are two well separated species: *D. retroversum* lies in the south near Piquetberg, on hilly quartz patches which are not usually farmed in this highly agriculturalised district. The plant is completely dormant in the summer, putting up one (or several) flat plump leaf-pairs in autumn, the leaves joined at the base and along one margin, the distal ends spread out, giving rise to the descriptive name 'duck foot mesem'. The other extremely dwarf species, *D. luckhoffii* (L.Bol.) Schwantes ex Ihlenf. (*Maughaniella luckhoffii*) occurs on quartz patches in the Knersvlakte near Vanrhynsdorp. It is distinguished from *D. retroversum* by being suberect, the leaves are symmetrically joined and the flowers are pedicellate. The whole plant, with the flower, measures less than 30 mm in height. The white to pink flowers have a short pedicel, the ripening capsule is red and very papillose, 5- to 6-locular, the expanding keels are dark brown, with broad wings, covering membranes almost transparent.

Oophytum N.E.Br. [colour p. 38]: Quartz fields north of Vanrhynsdorp in Namaqualand. A small genus of three species which resemble some species of *Conophytum*. Their name, which means 'egg plant', refers to the ovoid, pulpy plant bodies

formed by the fused opposite leaves which are sheathed in the dry season by the skeletonised remains of older leaf-pairs. The tufted plant is less than 25 mm high, and produces solitary flowers with white, pink-tipped petals or pure white. The sepals form a short green tube above the ovary, the capsule is 5- to 6-locular with broad membranous valve wings and covering membranes are absent or vestigial. The plants in undisturbed habitat present, by their sheer numbers, an unforgettable sight. The three species are distinguished by their shape, locality and time of flowering. Both *O. nanum* and *O. oviforme* overlap north of Vanrhynsdorp; *O. nanum* is much smaller, the plant bodies rounder and it flowers earlier than the bigger, cigar-shaped *O. oviforme*; both turn apricot shades in summer heat, both have pinkish flowers with white centres. *O. nordenstamii* has globular dark green plant bodies, has early, pure white flowers and is localised near Vredendal.

Disphyma N.E.Br.: A prostrate, stem-rooting genus which occurs in the coastal region of the south-western and southern Cape. The 3-angled to semiterete leaves are up to 30 mm long, arranged in dense clusters on horizontal stems which form mats. Flowers have pedicels up to 30 mm long, opening in the afternoon. The capsule is 5-locular, with winged keels and covering membranes, the closing body large and bilobed, giving the genus its name, which means 'double tubercle'. There are two species in South Africa: *D. crassifolium* (L.) L.Bol. which has trigonous leaves up to 30 mm long and pinkish flowers 40 mm across, and *D. dunsdonii* L.Bol. with shorter leaves 5-9 mm long and smaller flowers 25 mm across; the latter species is common around Bredasdorp. Translocation of coastal species from South Africa to other continents was undoubtedly aided by shipping, particularly in the early days when loading took place from the beaches. Australian species need to be examined against a detailed field study of South African species.

Glottiphyllum N.E.Br. [colour p. 38] ('tongue-leaved'): Centred in the Little Karoo but extending from Ceres in the west to the Eastern Cape. Everyone recognises *Glottiphyllum* but finds species identification extremely difficult. Over the last 170 years 59 names have contributed to utter confusion. Hartmann & Golling are to be congratulated on producing a remarkable monograph which is an example of how the taxonomy of a 'difficult' genus

should be tackled (*Bradleya* 11: 1-49, 1993). Plants are compact or mat-forming with stout storage rootstock, true leaves in seedlings only, later leaves being bracts of a perennial inflorescence, and are fleshy, soft, grey when the epidermal wax is thick and green when it is not, their arrangement (and this is important) being distichous (opposite in two ranks) or decussate (opposite in pairs set at right angles to each other). Leaves are erect or decumbent, equal (isophyllous) or unequal (anisophyllous), both of which characters are important in identification. The deep yellow flowers are large (50-90 mm across), with 4 sepals; capsules persistent or breaking off, spongy, with big spongy closing bodies. The authors recognise 16 species, of which the following nine have distichous leaves and compact habit: *G. carnosum*, *G. depressum*, *G. linguiforme*, *G. neilii*, *G. nelii*, *G. suave*, *G. grandiflorum*, *G. longum* (the most widespread species), and *G. oligocarpum*. In addition, *G. fergusoniae* and *G. salmii* are also compact, but with decussate, erect leaves. The following are mat-forming with decussate leaves: *G. cruciatum*, *G. difforme*, *G. peerisii* (distinctive with very unequal, white-margined leaves), *G. regium* (the largest species, leaves longer than 100 mm), and *G. surrectum*. (*G. ochraceum* with a 5-lobed calyx is a member of *Malephora*). Many fruits open hygrochastically and seeds are ejected by raindrops, but in 50% of the species the capsule later breaks off and becomes a tumble fruit; the persistent or free fruit is a further species-delimiting character. Precise localities are not given in the monograph, but species can now be identified by study of the Hartmann-Golling reference work combined with familiarity of all features of the specimen.

Drosanthemopsis Rauschert (*Anisocalyx*): Riethuis, Namaqualand. A much-branched, compact shrublet up to 150 mm high, with old leaves persistent. The opposite leaves are finely papillate, partly keeled, joined at the base and 25 mm long. The white flower is 40 mm in diameter, with unequal sepals and pure-white erect stamens. The single species was first described by L. Bolus as *Drosanthemum vaginatum* in 1935, however the capsule is 9- to 10-locular whereas in *Drosanthemum* the capsule has 4-6 loculi, and the species was later placed in a new genus as *Anisocalyx vaginatus*; this name was corrected to read *Drosanthemopsis vaginata* (L.Bol.) Rauschert (*Taxon* 31: 555). The capsule valves have awn-like wings, the covering membranes are well-developed and closing bodies are absent.

Dicrocaulon N.E.Br. ('Forked stem'): The genus consists of seven species of erect (up to 500 mm) or prostrate twiggy dwarf shrubs which occur between Vredendal and Hondeklip Bay in Namaqualand. There are two kinds of leaves: the first pair is small and roundish, joined for the greater part and forming a collar around the second pair which is longer and terete; all the leaves are succulent and papillate. The dried leaf-pairs leave a series of distinctive collars around the branch stems. The small to large flowers are white or magenta, with petals fine and thread-like or flat and relatively broad. The capsule is 4- to 7-locular, the valves have membranous margins, covering membranes present and closing bodies absent. A variable genus with some small-leaved, small-flowered species and others, like *D. grandiflorum*, with much larger leaves and wide open flowers. In the resting stage the plants appear to be dead.

Jacobsenia L.Bol. & Schwantes [colour p. 38]: A genus of two species named after Dr Hermann Jacobsen of Kiel, Germany, author of *Lexicon of Succulent Plants*. Both species occur in the Vanrhynsdorp area in Namaqualand. Vegetative growth is clustered at the base, producing erect flowering branches to a height of 300 mm. Each year two pairs of similar cylindrical leaves are produced, the leaves of the same pair being slightly unequal in length. The growth habit is similar to that of *Mitrophyllum* but the leaf-pairs are not dimorphic and they develop at the same time, not indicating a resting period. *J. kolbei* is a lanky plant up to 250 mm, its white flowers up to 50 mm across; *J. hallii* is said to be more compact. The flowers are terminal, solitary, and highly scented. The capsule is 5-locular, the valve-wings are recurved, the expanding keels diverge, ending in awns; covering membranes present without closing bodies.

Mitrophyllum Schwantes [colour p. 38] (*Conophyllum*, *Mimetophyllum*): Richtersveld. Sparingly branched, erect, twiggy plants which have extraordinary succulent leaves. Each branch produces two pairs of new leaves each year: the first pair is joined only at the base, the second pair is united from part to nearly all of its length into a long, soft, conical body which gives the name to the genus ('bishop's mitre leaf'). As in the following two genera the marked heterophylly generally represents a year's growth. The revision of the genus by Hans-Helmut Poppendieck was published in 1976; this detailed investigation resulted in the reduction

of the number of species to six. *M. roseum* has the most southerly distribution of the group, occurring near Komaggas in Namaqualand. It is distinguished by its reddish-violet flowers and filaments which are papillose at the base; the rest of the species have white or yellow flowers and glabrous filaments. In both *M. mitratum* and *M. abbreviatum* the internode below the bracts on the flowering branch is compressed and less than 3 mm long; *M. mitratum* has variable habit from compact clumps 150 mm tall to branching up to 600 mm. The flowers are white, with reddish tinge, with golden-yellow anthers and appear before the growth period commences. *M. abbreviatum* occurs near Augrabies in Namaqualand and has white to pink flowers, whitish anthers and is a narrower plant than *M. mitratum*. In the remaining three species, the internode below the floral bracts is from 3-120 mm long. *M. grande* is localised to the north of Augrabies. Its flowers are yellow or pure white, the anthers golden-yellow. Both *M. clivorum* and *M. dissitum* have whitish anthers and are distinguished by the bracts on the flowering branch: in *M. dissitum*, these are sharply pointed and less than 15 mm long, in *M. clivorum* the bracts have round ends and are up to 30 mm long. The plants are long-flowering and the flowers scented.

Monilaria (Schwantes) Schwantes [colour p. 38]: From Vanrhynsdorp to northern Namaqualand. The name means 'strings of pearls' – referring to the beaded structure of the stem. In 1973 a monograph by H.-D. Ihlenfeldt and S. Jorgensen was published in which the species of *Monilaria* are reduced from 11 to 5. The genus consists of small clump-forming plants with thickish stems shortly jointed like a bead necklace; the paired leaves are of two kinds and appear annually; the first pair forms a bag or sheath which is pushed open by the secondary leaves which are more conventional, being long, cylindric, and functional in making food and storing water. The solitary, terminal flower (40 mm in diameter) is white, yellow or violet-red and has a long pedicel. The capsule is 5-to 7-locular, the expanding keels diverging with narrow wings, covering membranes are present, closing bodies absent. Three of the five species have a southerly distribution, chiefly between Vanrhynsdorp and Nuwerus: *M. moniliformis* (*M. peersii*) has round, soft, short-collared sheaths which completely cover the leaves for the next growth period. In *M. pisiformis*, the leaf-sheath is cup-shaped and smaller than in the other species; the leaf-sheath of *M. chrysoleuca* is

similar to the latter but much larger. In var. *chrysoleuca* the leaves are covered with papillae whereas in var. *polita* the shining leaves are smooth. *M. obconica* Ihlenf. & Jorg. occurs near Springbok; its leaf-sheath is 4-sided and folded, hard, very long and sometimes split. The most northerly species is *M. scutata*, in the typical subspecies which occurs north of Wallekraal the sheath is very hard and quadrangular, while in subsp. *obovata*, which extends from Riethuis to north of Kleinsee, the very hard leaf-sheath is almost egg-shaped with a short collar. The highly scented flowers appear from autumn to winter.

Meyerophytum Schwantes: Small branching shrublets which occur from the Richtersveld to southern Namaqualand. The plants have two kinds of leaves on slender short stems which do not seem to have the beaded appearance of *Monilaria*; the first leaf-pair forms a shortened, rounded body, the second pair is longer, fused for about one-third of its length. All green surfaces are densely papillate. The first leaf-pair eventually forms a sheath which enfolds the next season's leaves. The large purple or purple and white flowers are pedicellate, and appear in spring, noon-opening. There are 5 short feathery stigmas, the capsule 5-locular (according to Bolus 5-7 locular) with stiff covers, winged valves and broad expanding keels. In 1958 L. Bolus devised a key to 4 species but this has not been recognised as only the Schwantes species *M. meyeri* is listed in modern literature, and *Tax. Lit. of S. Afr. Plts.* (Meyer et al. 1997) indicates that revision is required. *M. meyeri* var. *holgatense* occurs at Riethuis near Hondeklip Bay, the typical variety has a much wider distribution.

2.4 Delosperma Group

Leaves terete or 3-angled with bladder cells and/or hairs, flowers have 5 separate nectaries, filamentous staminodes, capsules with or without covering membranes, expanding keels and sheets separate, closing bodies absent, valve wings broad, often with seed pockets.

The 10 genera in this group exhibit widely different habit, from the two succulent dwarfs which co-exist in the Little Karoo, *Gibbaeum* and *Muiria*, to quite large bushy genera like *Drosanthemum* and *Mestoklema*. The other genera are *Corpuscularia*, *Oscularia*, *Delosperma* s.str., *Malephora*, *Ectotropis* and *Trichodiadema*. Hartmann includes here

Lampranthus p.p. but this genus will be noted in Group 2.9. Most of these await revision, so their position and parameters are uncertain.

Gibbaeum N.E.Br. [colour p. 38] (*Imitaria*): Main distribution in the Little Karoo; common in the Ladismith area and extending south-westwards to Swellendam and northwards to Touws River. In Jacobsen's *Lexicon* (1970) 21 species of *Gibbaeum* are listed. The genus has been researched by H.F. Glen who reduced this number to 15 species and one subspecies; this number is increased to 16 with the description of *G. johnstonii* Van Jaarsveld & Hammer (*Bradleya* 14, 1996). The species of *Gibbaeum* are neat, easily cultivated clump- or mat-forming plants in which the leaves of a pair are dissimilar, free or joined at the base, or almost fully joined forming a rounded body as in *G. cryptopodium* (*G. nuciforme*) or the leaves may elongate as in *G. pachypodium*; often pubescent and velvety which feature sometimes imparts a whitish or silvery colour as in *G. pubescens*, blending the leafy clumps into the white quartz pebbles amongst which they grow. Others like *G. heathii* are smooth. The pedicellate flowers are pink to reddish-violet, sometimes white (never yellow). The capsule is 6- to 7-locular, rarely more, the expanding keels ending in large broad wings, and covering membranes are present.

Muiria N.E.Br. [colour p. 38]: In the Riversdale district in the Western Cape. Sufficiently distinct to



Muiria hortenseae

be retained as a monotypic genus: in *M. hortenseae* the leaves are completely united to form a softly pubescent ovoid body. In its long resting stage, the body is enclosed in the dried skin of the previous pair of leaves; an older plant may consist of up to 8 or more of the soft green bodies. An interesting account of the idioblasts (single cells different to the tissue in which they occur) is given by N.E. Brown in *Mesembryanthema* (Brown, Tischer & Karsten 1931): on opening the leaf-body in the resting stage he found large water-storing cells 1-3 mm in diameter, while the rest of the leaf tissue had been absorbed; on exposing these cells at room temperature, ten days passed before any showed signs of collapsing. Their resistance to desiccation is obviously of great importance to the plant's survival. The small pinkish flower emerges shortly through the obscure fissure, and the capsule, which is 6- to 7-locular, lacks covering membranes and closing bodies, the nectar glands are nearly contiguous. *M. hortenseae* is highly localised and shares its habitat with *Gibbaeum album* with which it is known to hybridise.

Drosanthemum Schwantes [colour p. 38 and 39] ('dew flower'): The centre of distribution of this spectacular group of low-growing or erect shrubs is the Western Cape, from where they extend into the Northern Cape, Free State, Eastern Cape and northwards through Namaqualand into Namibia. More than 100 species have been described, of which about 6 occur in Namibia, and approximately the same number in the Eastern Cape. The genus is in the process of revision and it is expected that the species number will be reduced. The plants are easy to recognise because of the glittering papillae on the short terete to 3-angled leaves, the slender, brittle stems often hairy or rough, the separately-erect flowers up to 30 mm or more in all shades of red, yellow, orange and white and sometimes in bicolours, in several species black staminodes further enhance the already beautiful flower. The capsule is 4- to 6-locular, with valve wings, covering membranes are present, closing bodies usually absent but in some species the seed exits are partly blocked by a protuberance originating from expanding tissue. *D. speciosum* (600 mm) grows in the Robertson area and has bright orange to crimson flowers up to 50 mm in diameter. *D. micans*, *D. thudichumii* (1 m tall with white or yellow flowers), *D. collinum* (yellow) and *D. bicolor* (flowers red with yellow eye) are closely related species and when well grown are the most spectacular of the

shrubby mesems. *D. littlewoodii* from Namies Kloof in Namibia is only 90 mm tall, its prostrate stems spreading over 500 mm with glossy white flowers. It is best to grow these plants from seed because, unlike *Lampranthus*, they do not root easily from stem cuttings.

Mestoklema N.E.Br. ex Glen [colour p. 39] ('many small branches'): This genus of six species has an unusual distribution: from the Little Karoo eastwards to East London, and northwards in a broad central band covering eastern Northern Cape and western Free State. It is known from two widely separate localities in Namibia but is absent in western South Africa. Bushily branched shrubs from 250-700 mm tall in which the flowering peduncles persist and harden. The opposite leaves are minutely papulose, trigonous or nearly terete. Flowers are small, orange or yellow with separate nectar glands; the capsules are small and 5-locular. Often present are several large food-storing stem tubers, this is typical of *M. tuberosum*. In the Free State *M. tuberosum* is known as 'Donkie vygie' or donkey's fig, as these animals have been observed scraping the tubers out of the ground with their hooves. *M. arboriforme* of the Northern Cape develops a central trunk with tree-like habit.

Corpuscularia Schwantes: In rocky terrain from Port Elizabeth to Grahamstown in the Eastern Cape. It is a greyish-green shrublet which wedges and spreads into rock pockets (ideal for rockeries) and is familiar to many gardeners. The stems are covered with the short triangular (in section) conspicuously keeled leaves; the large white flowers appear in summer with a yellow centre of erect stamens. The 6 nectar glands are not joined, the capsule 6-locular, pale, and of the *Delosperma* type. The petals persist as a dark mass on top of the capsule. This genus has been united with *Delosperma* for many years, but in 1991 Hartmann placed it separately with caution, predicting a future possible 35 species. *C. lehmannii* is the popular compact garden plant; *C. taylorii* has long internodes and develops trailing branch stems.

Oscularia Schwantes [colour p. 39]: Western Cape: most species (11, probably more) seem to lie in the Clanwilliam to Piquetberg areas, with 5 species as far south as Malmesbury and Worcester and only 2 in Vanrhynsdorp to Calvinia area to the north. Hartmann (*Bradleya* 16, 1998) distinguishes *Oscularia* in the following manner: early on, the pres-

ence of teeth on leaf margins became an essential character and this excluded many similar species which were left in *Lampranthus*. But *Oscularia* differs from *Lampranthus* in having a thick wax layer and calcium oxalate in the epidermis which results in whitish leaves, whereas *Lampranthus* leaves are firm and darker. Schwantes recorded the almond (and other) scent of the flowers which is characteristic. The fruit differences are slight: *Oscularia* has a closing ledge whereas *Lampranthus* has rodlets, and the fruits of the latter persist for a long time while those of *Oscularia* disintegrate more quickly. Hartmann points out that her species list, given here, agrees largely with that of Glen (unpubl. 1978). A key is not provided, making identification somewhat difficult especially as five species are of uncertain/unknown locality, and a few lack other details.

Oscularia is erect to spreading and decumbent, shrubby, internodes reddish-brown (rarely grey), bluish to grey-green trigonous leaves opposite, the margins and keels of several species are dentate. The white to deep pink flowers are borne terminally and conspicuously in cymes (making it a good rockery plant), the scented flowers open day and night, nectar glands distinct, capsule 5-locular, with low rims above, of soft tissue, covering membranes complete with closing ledge, valve wings very broad, stamens (and filamentous staminodes) centrally collected. Hartmann gives 23 species, most of which are new combinations from *Lampranthus*: *O. alba* (*Lampranthus albus*), *O. caulescens*, *O. cedarbergensis* (*L. cedarbergensis*), *O. compressa* (*L. compressus*), *O. comptonii* (*L. comptonii*), *O. copiosa* (*L. copiosus*), *O. deltoides*, *O. excedens* (*L. excedens*), *O. falciformis* (*L. falciformis*), *O. guthrieae* (*L. guthrieae*), *O. lunata* (*L. lunatus*), *O. major* (*O. deltoides* var. *major*), *O. ornata* (*L. ornatus*), *O. paardebergensis* (*L. paardebergensis*), *O. pedunculata*, *O. piquetbergensis* (*L. piquetbergensis*), *O. prasina* (*L. prasinus*), *O. primiverna* (*L. primivernus*), *O. steenbergensis* (*L. steenbergensis*), *O. superans* (*L. superans*), *O. thermarum* (*L. thermarum*), *O. vernicolor* (*L. vernicolor*) and *O. vredenburghensis* (*L. vredenburghensis*).

Delosperma N.E.Br. [colour p. 39] ('visible seed'): The genus has an unusual and amazingly long distribution, mainly eastern, from the Eastern Cape (where most species occur), Free State and Kwa-zulu-Natal, in a corridor to northern Africa and Arabia, side-stepping Mozambique on the way and keeping to the moist highlands. It is also present in

the Western Cape, and to a much lesser extent in drier Namaqualand, with a low presence in Namibia (*D. klinghardtianum*). About five species are known to occur north of the Limpopo: two in Zimbabwe (*D. mahonii*, *D. steytlerae*), and several in north Africa (*D. abyssinicum*, *D. nakurense*, *D. oehleri*). More than 150 species have been described in this large variable genus which awaits revision. It is probably one of the oldest members of the Mesembryanthema, as it possesses a primitive capsule in which the seeds lie exposed. The species are herbaceous or shrubby, erect or prostrate, rootstock or tubers may be present; opposite leaves are extremely variable in shape, size, surface and colour. The flowers (white, yellow or pink shades) are solitary or in cymes, 20-70 mm in diameter, borne on pedicels 10-50 mm long which possess bracts. There are 5 large separate nectar glands. The capsule is 4- to 6-locular with valve wings and parallel expanding keels; covering membranes and closing bodies are usually absent. There is therefore no means of delaying seed dispersal in this genus. One cannot help concluding that this is associated with its wide distribution and accompanying variation; and that the delayed dispersal mechanism which is considered to be a later development is not in the best interests of long-term survival, since it must hold a species to a narrow locality, to which it becomes intensely adapted, and therefore unsuited to survive environmental change.

Ectotropis N.E.Br.: *E. alpina* is a very small tufted species which is rare on damp rocks in the mountains of the Hogsback, Eastern Cape. Its papillate glistening leaves are up to 4 mm long, flowers are very small, white and solitary, with about 25 stamens. The capsule is 5-locular and lacks covering membranes and closing bodies. It is doubtful whether this minute species should be separate from *Delosperma*.

Malephora N.E.Br.: A widespread genus of 13 species which have been recorded from the Eastern and Western Cape, Namaqualand, the Free State and Namibia. *Malephora* tends towards a bushy, erect or more often prostrate habit in which the branching stems have distinct internodes. The soft, semi-terete or bluntly 3-angled opposite leaves are up to 50 mm in length and often coated with a bluish wax. The orange, yellow or red flowers are up to 50 mm in diameter; the capsule is 8- to 12-locular, with valve wings, covering membranes present,

closing bodies absent or reduced. In some species, true seed pockets exist in the fruit. When prostrate it is a good cover plant (stems will root along their length) and has attractive flowers which have made it a garden plant for many years.

Trichodiadema Schwantes [colour p. 39] ('crown of hairs'): Species are centred in the Eastern and Western Cape, and in the southern karoo areas; diversity is very low in the Free State, Northern Cape, Namaqualand and Namibia. The usual habit is prostrate, mat-forming, wedging in rocks, less often the erect, bushy form up to 250 mm or more. Roots and stems are woody, with tuberous caudex. The short, nearly terete, papillate leaves have an apical cluster of hair-like bristles which is the outstanding feature of this genus. The unique diadem of hair-bristles is a mechanism for water uptake and develops from the lengthening of special idioblasts. Three different types of diadem have been recognised and are of taxonomic importance (Ihlenfeldt, H.-D. in *Mitt. Inst. Allg. Bot. Hamburg* 17, 1980). *Trichodiadema* can be distinguished from certain species of *Delosperma* which also have bristles but which are of different origin. This aspect has yet to be applied and it is expected that on revision the 30 or more described species of *Trichodiadema* will be reduced. *T. intonsum* has apical leaf bristles which converge to form a point, sharp enough to enter human skin and cause discomfort. Flowers are white, yellow or mauve, on short pedicels, the sepals also have apical bristles; the stamens are centrally collected, nectar glands separate. Capsule has 5-8 locules, with broad valve wings, covering membranes present or reduced, closing bodies absent.

2.5 *Stomatium* Group

Low, tufted or mat-forming, sometimes rhizomatous or at least rooting at the nodes, leaves xeromorphic with crystal deposits, surface rough or warty, often with toothed margin and/or keels, flowers yellow, rarely white, with 5 separate nectaries, capsules with or without covering membranes, no closing bodies, although reported in one species of *Chasmatophyllum* and obscure in *Orthopterum* (Herre 1971). Most genera require revision and four of them are monotypic or with few species. Most genera have an eastern distribution but *Stomatium* and *Rhinephyllum* proceed well into the western areas.

Nine genera are included here: *Faucaria*, *Orthopterum*, *Rabiea*, *Stomatium*, *Chasmatophyllum*, *Rhinephyllum*, *Neohenricia*, *Mossia* and *Frithia*.

Faucaria Schwantes [colour p. 39]: Distribution almost entirely in the Eastern Cape, mostly from Uitenhage to East London, associated with subtropical bush thickets, extending northwards through karoo to Graaff-Reinet, and slightly into the Western Cape. The genus was revised by Groen & Van Der Maesen (*Bothalia* 29(1), 1999) who reduced the species number from 33 to 6 species, three of which are highly localised. The plants form clumps up to 100 mm high, paired leaves are equal, often with aggregates of calcium oxalate crystals visible as dots; the leaf is triangular, keeled and chinned, the margin toothed or almost entire, the teeth often bristle-tipped. Flowers solitary, yellow, with flat pedicel and no bracts, staminodes absent; flowers open in late afternoon in the late summer. Capsule is 5-locular, woody, with deep locules covered by bent lamellae, covering membranes and closing bodies absent. *F. felina* subsp. *felina* has the widest distribution, karoid and coastal, with large populations at Cradock and along the Eastern Cape river valleys; it absorbs the bulk of the synonymy. It is variable, with toothed, white-dotted leaves, thin wax cover, glaucous or green, the flowers yellow, sometimes white, fruits detach easily. Subsp. *britteniae* extends from Grahamstown to Fort Beaufort; the leaves are whitish or glaucous, caused by numerous white dots; marginal teeth have long papillate bristles. Subsp. *tuberculosa* from near Bedford has whitish marginal teeth, the upper leaf surface is covered with unique whitish tubercles. *F. basscheana* has a wide karoid distribution from Prince Albert and Beaufort West to Graaff-Reinet and southwards; the upper leaf surface is shiny green, usually not dotted, with a conspicuous white border on margins and keel, with 0-3 teeth on each margin. *F. subintegra* from the Chalumna River course area has leaves with small, conical teeth, or no teeth, the surface minutely dotted. The remaining three species are highly localised: *F. nemorosa* occurs near Alicedale only, the leaf has a soft, dull epidermis, no white marks but green-spotted, the margins with reduced teeth. *F. gratiae* (*F. hooleae*) occurs near Riebeeck East only, it is very small with short shiny leaves, often reddish, with many small dots, 2-5 teeth on each margin. *F. tigrina* is restricted to a narrow area at Grahamstown; it is distinguished by the numerous leaf dots which converge into flecks, teeth well de-

veloped with long bristles. The authors of the revision regard the *Stomatium* group as polyphyletic and conclude that *Faucaria* is nearest related to *Orthopterum*.

Orthopterum L.Bol.: Eastern Cape, extending from Uitenhage through Albany to the Fish River. There are two species: *O. coegana* (from Coega, near Port Elizabeth) and *O. waltoniae*, which has slightly smaller dimensions, from the Albany district. Both plants are clump-forming and similar to *Faucaria*, their branchlets having 6-8 leaves up to 30 mm long with rounded keels, leaves of a pair not quite equal, apiculate, dark-dotted, margins smooth, or with several small teeth. The name *Orthopterum* means 'erect wing' and refers to the upright wings on the cell lids of the 5- to 6-locular capsule. As in *Faucaria* the flowers open in the afternoon.

Rabiea N.E.Br.: Compact dwarf plants in which the short stem is enclosed by the leaves. Six (or less) species occur in the Eastern Cape, the Free State and near Kuruman in the Northern Cape. The leaves of a pair are often unequal, sickle-shaped, usually keeled and apiculate with conspicuous raised pearl-like white, or reddish-brown dots. The flowers are subsessile in yellow or gold and about 30 mm in diameter. The capsule is 7- to 14-locular with winged valves, the keels are erect and covering membranes are present. The genus is under revision; according to Hartmann the presence of an hypanthium and separate nectar glands indicate a possible relationship to *Stomatium* and *Rhinephyllum*.

Stomatium Schwantes [colour p. 39] ('open mouth'): The genus is selective of arid regions and has its greatest diversity around Cradock in the Eastern Cape, followed by about 16 (or less) species in the southern and central karoo from Laingsburg to Beaufort West and Carnarvon, with only two species in the west (Clanwilliam, winter rainfall), about five from Prieska to Bushmanland, and only one in the Free State. There are 39 (unrevised) described species, the species names and number may change, but the distribution will not. These small, clump-forming plants have very short stems, the leaves rough with white or transparent dots; leaves of a pair are sometimes unequal in length, more or less keeled towards the leaf-end, the lower surface drawn up like a chin, the angles usually toothed, giving the 'open mouth' appearance. Some species,

like *S. suaveolens*, have smooth margins but are densely papillate. The solitary flowers are yellow, rarely white, about 20 mm across, scented and open in the afternoon and at night in the spring. The capsule has 5 deep loculi with reduced or well-developed covering membranes, closing bodies absent.

Chasmatophyllum Dinter & Schwantes [colour p. 39]: Six species have been described and these are recorded from Graaff-Reinet and Willowmore in the Eastern Cape, the Free State and surrounding territory, and westwards in the southern karoid areas; one species is present in Namibia. Small, woody-stemmed prostrate plants which sometimes form mats, spreading by means of short underground rhizomes. The branchlets bear 6-8 fleshy leaves obtusely keeled with 1-2 apical teeth and are scabrid with prominent whitish tubercles. The stalked yellow flowers are up to 50 mm high. In the 5-locular capsule the covering membranes partly cover the seeds and this distinguishes the genus from *Rhinephyllum*, in which the covering membranes are absent or very reduced. The genus is closely related to *Stomatium*.

Rhinephyllum N.E.Br. [colour p. 39] ('file leaf'): Mainly Western Cape Province in karoid areas from Ceres to Fraserburg, Victoria West, and Graaff-Reinet, and southwards to Prince Albert and Jansenville. Thirteen species have been described, as well as *Neorhine pillansii*, from Laingsburg, which was transferred to this genus by Herre & Volk. Hartmann referred to the unrevised genus as 'highly heterogenous'. Habit varies from small compact shrublets to low tufted plants; the leaves usually clavate and flat above, rounded or keeled below, the surface rough with raised hard white tubercles, leaf margin smooth, rarely toothed. The yellow, stalked flowers are about 20 mm across; the capsule is flat above, the covering membranes absent or reduced. *R. macradenium* and *R. frithii* do not have warty leaves and probably do not belong here.

Neohenricia L.Bol. [colour p. 40]: A miniature genus which occurs on pans from Victoria West in the Great Karoo to Fauresmith in the Free State, and localised in the Eastern Cape. A mat-forming, rooting plant, the tiny leaves ascending, flat above, convex below, joined at the base, smooth below but toward the apex covered with raised warts. The leaf colour, grey to brown, mimics the surrounding

gravel. The solitary scented flowers are pedicellate, white to pink, opening at night in the summer. Capsule is 5-locular, nectar glands in a ring, according to Carter's excellent illustration in *Gen. of Mesembryanth.* (Herre 1971) the ovules have basal or parietal placentation, not central. There are no closing bodies. There are two species: *N. sibbettii* which has the northern distribution given above, and *N. spiculata* Hammer, isolated near Sterkstroom in the Eastern Cape where it grows in cracks in dolerite outcrops.

Mossia N.E.Br.: The single species, *M. intervalaris*, has an eastern distribution from Barkly East in the Eastern Cape through the eastern Free State and patchy in Gauteng and Mpumalanga. A dwarf prostrate plant with creeping stems which root at intervals. The small glaucous leaves are opposite, erect, smooth and joined at the base, clustered at intervals. The white flowers are solitary, almost sessile and open at night, the sepals and petals tend to form groups. The capsule is most often 5-locular, the loculi open with seeds exposed, covering membranes and valve wings are absent.

Frithia N.E.Br. [colour p. 40]: Two species are found at separate localities to the west and east of the Gauteng Province (Transvaal) in the summer rainfall region. The inclusion of *Frithia* in this group (albeit tentative) is not immediately apparent; it is isolated in the north, it is a sunken plant with a few fleshy roots, the alternate leaves forming a small rosette of truncated leaves. *F. pulchra*, meaning 'beautiful', is well-named as the small rosette of buried finger-like leaves produces a striking flower (25 mm across) in glossy magenta shading to white and yellow at the centre. It is present on the Magaliesberg Range in the west. The recently described *F. humilis* Burgoyne is a separate occurrence of white, yellow-centred flowering plants which occur to the east, on both sides of the border between Gauteng and Mpumalanga. A much smaller form cohabits with *F. pulchra*. In the dry season the leaf-tips withdraw into the soil. The window device at the truncated leaf-tip used in subterranean genera like *Lithops* and *Fenestraria* occurs again here. *Frithia* is distinguished from *Fenestraria* (which has similar leaf habit) by its leaf-tips, which are finely papillose, whereas *Fenestraria* has smooth leaf-ends. The 5-locular capsule is fragile, breaking up when mature or becoming a tumble fruit; covering membranes are absent.

2.6 Titanopsis Group

Fleshy taproots or rhizomes, leaves in a rosette or as a single pair, surface smooth or warty, flowers solitary with nectaries in a ring, capsule with or without covering membranes, valve wings broad but tapering distally, without or with very small closing bodies. Most genera are highly adapted and need to be grown under controlled conditions. Thirteen genera are included here: *Titanopsis*, *Aloinopsis*, *Nananthus*, *Tanquana*, *Vanheerdea*, *Hammeria*, *Ihlenfeldtia*, *Dinteranthus*, *Lithops*, *Schwantesia*, *Lapidaria*, *Didymaotus* and *Vlokia*.

Titanopsis Schwantes [colour p. 40] ('chalky appearance'): In this genus of tufted dwarfs with thickened rootstocks the development of whitish warts seems to reach its extravagant limit. Five species occur in Griqualand West, Bushmanland and Namibia. The best known is *T. calcarea* which has spatulate, crowded leaves and yellow flowers, and the most interesting is *T. schwantesii* which grows amongst broken limestone at the foot of the Karas Mountains in Namibia: its pustular appearance makes the segments look more like ancient reptilian feet than the leaves of a modern plant. The scented flowers open in late afternoon; the sepals are pustular like the leaves. The capsule is 5- to 6-locular, the expanding keels finely toothed and diverging, with membranous margins, the loculi have semi-transparent covering membranes. According to Hartmann, this genus is closely related to some species of *Aloinopsis*, but differs from it in some fruit characters, the fruit having a persistent stalk and a flat top.



Titanopsis calcarea

Aloinopsis Schwantes [colour p. 40]: Dwarf, tufted plants with substantial tuberous rootstock; their distribution lies well to the south of *Titanopsis*; largely in the Great Karoo and spreading from west to east. There are about 12 species in this unrevised genus; the plants known as *A. orpenii* lie far to the north of the southern distribution and are almost certainly not part of the complex. Most *Aloinopsis* species have broadly spatulate leaves from 3–9 mm thick with rounded apices, while others have thicker trigonous leaves which may be smooth or textured. The rough leaves have raised tubercles and in *A. setifera* some of the tubercles end in bristles. The scented flowers are pinkish or yellow, the latter sometimes having a red stripe. The capsule is 6- to 14-locular, the keels aristate and covering membranes are present. *Aloinopsis* has a history of confusion with **Nananthus** N.E.Br. [colour p. 40] and other genera. *Nananthus* is the older genus, and, in its unrevised state, occupies a northern position from the Northern Cape (Upington, Prieska) to the Free State and southwards to Aliwal North. *Aloinopsis* lies south and west of this distribution. *Nananthus* forms a small rosette of pointed, flattish leaves, usually widest at the middle, keeled, covered with pale spots which may be raised to form pearly tubercles. Both genera have a tuberous rootstock, and the tendency for a median petal stripe, and the presence of scented, noon-opening flowers is common to both. In *Nananthus* the capsule has 6–10 locules, expanding keels are erect, covering membranes are narrow and closing bodies absent. The old genus **Deilanthus** N.E.Br. is included in *Mesembryanthemum* of the World (1998) and presently contains two species extracted from *Aloinopsis*: *Deilanthus peersii* and *D. thudichumii*. The *Titanopsis*-*Aloinopsis* complex and related genera require further field investigation and full revision.

Tanquana Hartmann & Liede [colour p. 40]: Tanqua Karoo and south of Laingsburg in the Little Karoo in the Western Cape. The three species which constitute the genus at present were extracted from *Pleiospilos* by Hartmann & Liede (*Mitt. Inst. Allg. Bot. Hamb.* 21, 1986) on the grounds of having a *Titanopsis* fruit type; the capsule of *Tanquana* agrees with those of *Vanheerdea* and *Ihlenfeldtia*, producing a case for their common origin (Hartmann in *Bot. Jahrb. Syst.* 114, 1992). *Tanquana* has smooth, green or purplish leaves which are not at all lumpy or rock-like as in *Pleiospilos*. *T. prismatica* which is widespread forms a large cluster of branch stems each bearing a single leaf pair (or two

in the growth period), with old capsules interspersed. The leaves are convex on the lower surface. *T. archeri* forms smaller clusters; *T. hilmaritii* is the smallest species and tends to remain unbranched. The yellow, scented flowers appear in autumn, opening in the afternoon. The capsule is 10-locular, with covering membranes and small closing bodies.

Vanheerdea L.Bol ex Hartmann: Two species occur in south-western Bushmanland on limestone soils, in the zone between winter and summer rainfall areas. L.Bolus first described the genus under *Rimaria* which was an illegitimate name (see 'Revision of the genus *Vanheerdea*', Hartmann in *Bradleya* 10, 1992). Bolus's new name for the genus was *Vanheerdea*, which was invalidly published. Hartmann recognises two of the four species and gives new combinations for them: *V. primosii* (L.Bol.) L.Bol. ex Hartmann and *V. roodiae* (N.E.Br.) L.Bol. ex Hartmann. The plants are compact, having 12–40 short branches each bearing one leaf pair in the dry season. The leaves are yellowish-green, papillate, dentate on margins and keel, joined for more than half their length, with inflated appearance. The shape and nature of the leaf-tip separates the species: *V. primosii* is a sunken plant with flat, windowed leaf-ends, its flowers and capsules smaller than those of *V. roodiae*; it lies at the northern end of the distribution. *V. roodiae* rises above-ground, but withdraws in dry conditions if the soil is soft enough to permit this. Its leaves are usually distinctly keeled, the keel less obvious in turgid leaves, the leaf-tip hunched but not windowed. Scented flowers are yellow, up to 25 mm in *V. primosii* and 49 mm in *V. roodiae*; flowering in late winter, opening in the afternoon. The capsule is of the *Titanopsis* type: broad diverging keels, broad valve wings, well developed covering membranes which are thinner distally and collapse into the locule when the seeds have dispersed. In *Vanheerdea* the capsule is 10-locular and closing bodies are absent.

Hammeria Burgoyne [colour p. 40]: In the region of Sutherland, on the new border between Western Cape (central) and Northern Cape. Dwarf shrublets, erect or decumbent up to 150 mm long. Leaf pairs similar or dissimilar, grey or white, joined for up to one-third of their length, toothed near the leaf tips, covered with flaking or non-flaking wax. Flowers light pink, white-centred or magenta, 20–25 mm across, appearing in spring, the short staminodes centrally collected. Capsule 5-locular, with dark

tannin spots on the valves, covering membranes large, valves winged, expanding keels divergent, closing bodies absent or small. The capsule is unlike that of *Ruschia*, to which *Hammeria salteri* (L.Bol.) Burgoyne belonged (see note under *Lampranthus*, Group 2.9). A new species, *H. gracilis*, is described, distinguished by its longer, more lax stems, less connate leaves with thinner wax, and flowering well before *H. salteri*. Subsequent to this, the new combination *Hammeria meleagris* (L.Bol) Klak has replaced *H. salteri* (Bothalia, 2000).

Ihlenfeldtia Hartmann: Another genus which has the *Titanopsis* fruit type occurs on quartz patches in north-western Bushmanland. There are two species: *I. excavata* is found in the area between winter and summer rainfall, north of *Vanheerdea*. The second species, *I. vanzylii*, is located on the same latitude but further west, near Pofadder. Both species were included in *Cheiridopsis* until their removal from that genus (Hartmann 1988); separation was based on fruit characters. The genus is compact, branching to form clumps of up to 120 'heads' consisting of one pair of wedge-shaped leaves, keeled and laterally compressed, papillate and greyish. The solitary flowers have bracteate pedicels, the opened flower reaching extraordinary dimensions of up to 77 mm across (Hartmann in *Bot. Jahrb. Syst.* 114, 1992), increasing in size during flowering. The capsule is 10-locular with broad valve wings which narrow distally; covering membranes are thin and collapse distally into the locules when the seeds have been dispersed. Small closing bodies are present. The two species can be distinguished by their capsules: *I. vanzylii* has a rounded, cup-shaped capsule with high bracteoles which touch it; *I. excavata* has a narrow funnel-shaped capsule with bracts at the base of the pedicel.

Dinteranthus Schwantes [colour p. 40]: Broadly associated with the course of the Orange River, the four species of this dwarf genus lie on either side of the great river. Furthest west, near Warmbad (Namibia) is *D. microspermus* which also extends southwards to Pofadder, which is also the vicinity for *D. vanzylii*. *D. wilmotianus* extends from Pofadder to Kakamas on the Orange River. The eastern sector is occupied by the distinctive *D. pole-evansii* which extends to Prieska. The two fat leaves which make up the plant body are variously shaped and are used to identify the species by Niko Sauer who made a detailed study of this genus (*Aloe* 13(1) 17(3-4), 18(1-2), 1975-1980). With the exception

of *D. vanzylii* in which the leaf pair is almost completely united, with leaf-tips flattened and marked, and buried after the manner of *Lithops*, the other species grow aboveground. In *D. microspermus* the leaves have a wide gape (primitive, according to Sauer), with chalky white skin, and, in subsp. *puberulus*, the surface is green-dotted and velvety due to hair-like papillae. *D. wilmotianus* has very rounded leaves with distinct keel, there is a deep but narrow cleft. In *D. pole-evansii* the cleft shuts until pushed apart by the pedicellate 'fist' which holds the flower; the pale grey surface is rugose due to uneven epidermal cells, the yellow flower has an outer border of white petals, the petals turn black on withering. The flowers of *Dinteranthus* are solitary, yellow, and appear from February to July, the times staggered slightly for the species; stamens erect, staminodes absent. The capsule is 6- to 10-locular, valves broadly winged, covering membranes reduced with no closing body. For correct placement the capsular details are required for the whole group.

Lithops N.E.Br. [colour p. 40]: Patchy but widespread in Namibia where there are about 17 species, of which *L. ruschiorum* has the most northern position; diversity is greater in southern Namibia where most of the species occur. Eight species occur in the north-western Cape (interior of Namaqualand and Bushmanland). Distribution continues east in a broad band and with decreasing diversity to the Free State and western Transvaal provinces which are populated almost solely by *L. lesliei*. Inexplicably the central and much of the eastern Great Karoo support no *Lithops* species, but the distribution is picked up again by *L. terricolor* in the area north of the Swartberg Mountains, from Laings-



Lithops lesliei var. *venteri*

*Lithops dorotheae*

burg to Steytleville in the south and from Merweville across to Graaff-Reinet. The only other species which has a southern distribution is *L. comptonii* which extends from north-east of Ceres to Laingsburg. Present knowledge of the distribution of *Lithops* is due to the intensive field work undertaken by Desmond Cole.

The most famous mesem of all accommodates its human admirers by surviving in all climates, in sophisticated glass houses or on window sills. It is cryptic and sunken in nature, the kaleidoscopic flattened leaf-ends merging into the pebbles or grit of its habitat. Only when it puts up its white or yellow flowers from April to July does it advertise its presence. Cole in his fine monograph on *Lithops* (1988) kept to photographs of non-flowering plants so that pattern and shape of the leaf-ends were clearly shown. There are 36 species, the latest being *L. coleorum* Hammer & Uijls from the Northern Transvaal. The small capsule is 4- to 7-locular, the expanding keels apparently joined to form one central body, with divided apex, covering membranes reduced or none, without closing bodies. For correct placement (as in *Dinteranthus*) capsular details are necessary for the whole group.

Schwantesia Dinter: A small genus of eight species of dwarf, compact plants which extend from Lüderitz in Namibia south-eastwards to both sides of the Orange River in the Richtersveld and Bushmanland regions of the Northern Cape Province. The genus was erected by Dinter in 1927 and honours Dr G. Schwantes who made major contributions to the knowledge of the Mesembryanthema between 1916 and 1952, and who is best remembered for his delightful book *Flowering Stones and Midday Flowers*. The plants are cushion- or mat-

forming, with opposite, bluish-green, 3-angled, succulent leaves about 40 mm long, and which, unlike *Lithops* and *Dinteranthus*, have longer-lived leaves, the leaf sheaths cover the internodes of the compacted stems and are persistent. Paired leaves are unequal, glabrous or velvety, the margins and keel sometimes red and toothed near the apex as in *S. ruedebuschii*, less often entire as in *S. succumbens* which occurs south of Warmbad in Namibia. All species have yellow pedicellate flowers 30-40 mm in diameter; the capsule is 5-locular, expanding keels are contiguous with broad wings, the covering membranes are reduced. Larger, golden-yellow flowers 55 mm across are produced by *S. speciosa* which grows in Bushmanland. A new species, *S. constanceae* Zimmerman was published in 1996.

Lapidaria (Dinter & Schwantes) N.E.Br. [colour p. 41] ('a group of stones'): At different times, this dwarf succulent has been placed in *Dinteranthus* and *Argyroderma*, eventually receiving an entity of its own as a monotypic genus. *L. margaretae* is restricted to the vicinity of Warmbad in southern Namibia. It differs from other *Lithopinae* in that its 6- to 8-locular capsule has covering membranes. Older plants consist of several heads of 6-8 obtusely 3-angled opposite leaves shortly united at the base; the leaves are firm, smooth, brownish or cream-coloured, unmarked and distinctively darkened along all angles. The golden-yellow pedicellate flowers are up to 50 mm in diameter and are winter-flowering; nectar glands form a ring and both stamens and staminodes are present. The capsule has a winged pedicel, the expanding keels are broad winged, covering membranes are present without closing bodies.

Didymaotus N.E.Br. [colour p. 41]: Tanqua Karoo in the Western Cape. The name 'double flower' describes the unique habit of this dwarf plant in bearing twin whitish to deep pink flowers simultaneously from the sides of the spreading mouth of the leaf pair. The leaf pair is in itself a remarkable construction, the keel on the 'lower' side of the leaf is heeled in such a manner as to bring it forwards and over so that each leaf looks like a monk's hood in the growth season. In the resting season the leaf pair is closed, last year's shrivelled leaves lie at right angles to the current pair. The plant bodies are often single but small older clumps do occur. The leaves are waxy and greyish or bronzed by the sun. The single species is *D. lapidiformis*. The scented flower is axillary arising from between two bracts,

appearing in October and opening at noon. It is up to 40 mm across, with 6 unequal sepals, stamens erect, nectar glands in a ring. The capsule is 6-locular, the expanding keels divergent and serrated, covering membranes present with no closing bodies.

Vlokia Hammer: In shallow pans near Montagu in the western Little Karoo. Being in a mountainous area the plants are near or with elements of fynbos. This new genus has uncertain placement in the Ruschioideae. It is a dwarf plant, developing prostrate stems up to 100 mm long, with a few pairs of small, keeled, trigonous leaves up to 10 mm long, 8 mm thick and wide, stem-clasping at the base, spotted with idioblasts. Old leaves are persistent and black, giving the name to the single species, *V. ater*. The flowers are small, solitary, pink, appearing in spring and noon-opening; petals not widespreading, with 6 sepals, many filamentous staminodes surround the shorter stamens and are centrally collected into a column, nectar glands form a ring. The capsule is 5- to 7-locular, subglobose below, expanding keels parallel at first, divergent distally, valve wings absent, covering membranes present, closing bodies absent. After fruiting the plants remain inactive until autumn when a new leaf pair emerges (S. Hammer in *Cact. & Succ. J. (US)* 66, 1994).

2.7 *Dracophilus* Group

Mostly small compact plants, leaves xeromorphic with cells of different sizes, flowers usually solitary with a nectary ring, filamentous staminodes absent or rarely present, capsules mainly 5-locular, covering membranes absent or reduced without closing bodies. Genera highly adapted and therefore need to be grown under controlled conditions. Nine genera are included here: *Juttadinteria*, *Dracophilus*, *Namibia*, *Hartmanthus*, *Nelia*, *Psammophora*, *Jensenobotrya*, *Conophytum* and *Ruschianthus*.

Juttadinteria Schwantes: The genera *Juttadinteria* and *Dracophilus* both occur in desert area south of Lüderitz in Namibia. *Juttadinteria* is common in the Sperrgebiet and enters the northern Richtersveld. According to Hartmann (1991) there are about 5 species; the genus is closely related to and partly united with *Dracophilus*. It is distinguished from the latter by its 4 sepals (5 in *Dracophilus*), pedicel without bracts and poorly developed cov-

ering membranes. The plants in this mixed group all have succulent leaves and woody roots, with short erect or prostrate branches, forming cushions or, as in *J. suavissima*, shrublets up to 300 mm; the leaves trigonous to almost cylindrical, glaucous, the margins of the angular leaves toothed, the paired leaves often densely packed on the short stem. Flowers are white, strongly scented, winter-flowering and noon opening, nectar glands form a ring. The capsule is 8 (or more)-locular, with valve wings, expanding keels contiguous, diverging at their tips, covering membranes reduced with no closing bodies. **Dracophilus** (Schwantes) Dinter & Schwantes [colour p. 41] extends from Lüderitz to the Richtersveld. Schwantes named this genus 'friend of the dragon' because one of the species occurs on the Drachenfels near Pomona in Namibia. These are small, cushion-like plants with densely-crowded, opposite, trigonous leaves which are rough, bluish-green with a few marginal teeth. The flowers are white or pink, with a bracteate pedicel and open in the evening. The capsules are 8 (or more)-locular, the expanding keels toothed with well-developed covering membranes. There are four species: *D. delaetianus* occurs in south-western Namibia; it forms cushion-like clumps 100 mm wide and 50 mm high; the oblong-ovoid leaves are 20-30 mm long, flat on the face and bluntly keeled on the reverse, toothed near the apex. The solitary flowers are pink with white stamens, the sepals non-fleshy. *D. montis-draconis* is found on the Drachenfels near Pomona in Namibia. Its leaves are 30-50 mm long, obtusely triangular, bluish-green with a few tubercles at the tip, the flowers white or pale pink with fleshy sepals. *D. dealbatus* occurs from northern Namaqualand to south of Witputz in Namibia. Its short stems bear 4 leaves, with entire margins, up to 45 mm long, smooth, light-green and thickest at the tip; *D. proximus* is present in much the same region; it has stems up to 60 mm and leaves are thickest near the base.

Namibia (Schwantes) Schwantes [colour p. 41]: Dwarf clump-forming plants which occur near Lüderitz and southwards to Pomona in southern Namibia. The short branches bear 4-6 greyish-white leaves, softer and larger than in *Juttadinteria*, margins always entire, boat-shaped with a rounded keel and covered with small white dots. The flowers in which the petals tend to group themselves are about 30 mm in diameter, with 5 sepals, the stamens centrally collected but not conical, the capsule 9- to 25-locular, the covering membranes ab-

sent or reduced, no closing bodies. Two species are listed at present: *N. cinerea* has violet, almost sessile flowers which, once open, do not shut again. In *N. pomonae* the flowers are white with pedicels up to 12 mm long, the flowers open in the morning and shut at night. The species names are not certain as this genus awaits revision as does the rest of this complex.

Hartmanthus Hammer: Northern Richtersveld (N. Cape) and Sperrgebiet in southern Namibia. Small to medium shrublets, erect, compact or spreading. The keeled greenish-grey leaves are laterally compressed and naviculate, with rough surfaces. Flowers with slight scent appear in late winter on flattened pedicels. Capsules 6-locular, pale, with no covering membranes and no closing bodies which characters included these plants under *Delosperma* until their separation. (Hammer in *Haseltonia* 3, 1995). There are two species: the compact *H. hallii* has pinkish flowers and very rough leaves; the looser growth form, *H. pergamentaceus* which is white-flowered, with longer internodes, cohabits with *Juttadinteria albata* which has a similar habit.

Nelia Schwantes: The genus is named after the late Prof. G.C.Nel, of the University of Stellenbosch, where he founded the botanical garden from which Hans Herre contributed so much to the knowledge of succulent plants. G.C. Nel wrote *Lithops* (1946) and *The Gibbaeum Handbook* (1953). *Nelia* is restricted to the Richtersveld in northern Namaqualand. The species are tufted, stemless plants forming clumps or cushions with almost terete or shortly keeled bluish-green leaves about 30 mm long and 8 mm thick. Four species are presently listed but, as suggested in *Mesembs of the world* (1998) there are probably only two. In *N. schlechteri* the short, fat leaves are slightly 'chinned' at the expanded apex, apiculate, the margins slightly serrate; in *N. pillansii* the crowded leaves are longer and have smooth margins. The white flowers are small and unattractive with a deep-based green ovary and 5 spreading sepals, the flowers 1-3 on bracteate peduncles; after opening they remain open for up to three weeks. The capsule is 5-locular, valves recurved when open, the yellow keels are broadly winged, the covering membranes are reduced with seeds exposed, closing bodies absent.

Psammophora Dinter & Schwantes ('sand bearing'): From Lüderitz in Namibia to the Orange River, two of four species just entering South Af-

rica at Beauvallon and near Sendelingsdrift in the Richtersveld. Habit varies from shrubs up to 600 mm tall to compact dwarfs. The flowers are solitary, pedicellate with two pairs of bracts. The capsule is 5- to 6-locular, without closing bodies and the covering membranes are reduced or absent. The genus was reviewed by Hartmann (*Bradleya* 14, 1996) in which she described a new species *P. saxicola* which is restricted to steep mountain sides in southern Namibia west of Sendelingsdrift. *Psammophora* is one of two members of Mesembryanthema which have sticky leaves to which sand adheres (probably with heat-reducing function). In *Psammophora* the gluc is made under the cuticle, which bursts, setting it free. (*Arenifera* also has sticky leaves but its different capsular structure places it away from *Psammophora*). Hartmann traces two groups in this genus: one with shrubby habit and 4 sepals, the other with compact, sunken growth and 5 sepals. *P. modesta* and *P. saxicola* are shrubby; the pink-flowered *P. modesta* is low-growing and widespread, its capsule 6-locular and lacking covering membranes. *P. saxicola* is localised, tall, up to 600 mm, leaves bright green, flowers white, capsule of *Dracophilus*-type, covering membranes present but incomplete. *P. longifolia* and *P. nissenii* are compact dwarf plants with only the leaves, or leaf-tips, showing above the soil surface.

Jensenobotrya Herre: The single representative, *J. lossowiana* is a unique mesem which is completely isolated on Dolphin Hill situated between Walvis Bay and Lüderitz in Namibia, inaccessible except by boat or by crossing the lagoon at very



Jensenobotrya lossowiana

low tide. Specimens seen in cultivation rarely resemble the thick, woody ancient vines which hang down the slopes in its natural habitat, bearing, as its name implies, a mass of almost globose, smooth, reddish and juicy leaves 12-15 mm in diameter ('botrya' means 'bunch of grapes'). According to Herre, who described the species in 1951, some of the plants on Dolphin Hill may be a few hundred years old, surviving, like *Welwitschia mirabilis*, on the fog rolling in from the Atlantic. The pale pink flowers are 20-25 mm in diameter, with pedicels of 10 mm, nectar glands in a ring, many stamens, appearing in autumn and winter. The capsule is 5-locular, the expanding keels ending in streamer-like wings, no covering membranes or closing bodies. The names of this plant commemorate Emil Jensen (who sent specimens to Herre) and Dr Von Lossow of Lüderitz; its discoverer was Mrs Buderus.

Conophytum N.E.Br. [colour p. 41]: About 75% of some 88 species of *Conophytum* lie in Namaqualand (from the Orange River to the Olifants River), concentrated in the north, with some species occurring in Bushmanland at Pofadder and even Kenhardt. About nine species occur in southern Namibia; in the southern Cape there are comparatively few species: about seven in the south-western Cape, decreasing to four in the Worcester-Robertson Karoo (*C. ficiforme*) and Little Karoo (*C. piluliforme*, *C. joubertii*, *C. truncatum*). It is surprising that in the species-rich Prince Albert-Oudtshoorn-Steytlerville area there is only one *Conophytum* species, *C. truncatum* (refer to distribution maps in *The genus Conophytum* by S. Hammer 1993). The early work on this genus by Schwantes & Tischer was continued by Rolf Rawe, who believed the nature of the epidermis to be the only reliable distinguishing feature (*Excelsa* 4, 1974). Rawe published keys to several sections of *Conophytum* and there was an appreciable reduction of the approximate 300 described species. In 1993 Hammer's revision of *Conophytum* was published; he suggested his work was a prodromus (introductory treatise) and work on it continues; there are still 146 names at species level and lower, which seems a great number; on the other hand the records often cluster around towns and along roads, and western South Africa is a big place. *Conophytum* predilects craggy, rocky sites, often perpendicular, at the tops of hills and mountains, entrenched in cracks, sometimes flowing out of the fissures and carelessly carpeting the rock layers (see *Aloe* 35(2), p. 56, 1998); they are also found

on quartz flats. They keep to winter rainfall areas which narrows the distribution.

The best known form which *Conophytum* adopts is that of a small cushion of button-like heads which have a narrow apical slit; the bodies are covered with a dried skin in the dry season and produce a 'shaving brush' flower in yellow, pink, mauve or white in the short growth period when the new fused leaves burst through the old sheath. Other growth forms include those in which the plant body is more than 20 mm long and drawn out into blunt or acute leaf-ends, as in *C. bilobum*, or the plant body is globose, as in *C. calculus*; there is the solitary 'Mount Vesuvius' form of *C. burgeri*, the windowed leaf-tips of *C. limpidum*, the warty leaves of *C. khamiesbergense* and the thick, mucronate, opaque leaves up to 40 mm long in *C. herreanthus*. The flowers are usually solitary, with bracts often concealed, 4-6 sepals and nectaries in a ring, most often autumn-flowering. The capsule is 4- to 8-locular, covering membranes and closing bodies absent.

Ruschianthus L.Bol: The single species, *R. falcatus*, has a restricted distribution in southern Namibia. A tufted succulent; its leaves grey due to wax and crystal deposits, with white patches on the slightly rough surface of the strongly falcate leaves (laterally compressed into a sickle shape). The plants are compact and fairly small, 50-70 mm tall, with greenish-yellow flowers on short pedicels which are bracteate. Winter-flowering and once fully opened they do not close again; the petals do not spread widely. Bearded filamentous staminodes are present (unusual in this group) with 5 nectar glands slightly separated, the capsule is 5-locular, without covering membranes or closing bodies.

2.8 Bergeranthus Group

Mostly low-growing tufted or mat-forming plants, less often branched shrublets, leaves homocellular xeromorphic, smooth-margined, rarely dentate, flowers mostly in extended inflorescences, nectaries separate, capsules with complete covering membranes, closing bodies present or absent, valve wings reduced. Seven genera are included here: *Bergeranthus*, *Machairophyllum*, *Rhombophyllum*, *Hereroa*, *Bijlia*, *Cerochlamys* and *Carruanthus*.

Bergeranthus Schwantes: Eastern Cape: There are 10 species in the unrevised genus which occur in

subtropical bush vegetation from Uitenhage to East London and northwards through karoo to Cradock. Some have place names such as *B. katbergensis* of the Winterberg Uplands, and *B. addoensis*, but it is likely that some of these names will be dropped. *B. glenensis* which lies outside this area is a synonym of *Hereroa glenensis* (N.E.Br.) L.Bol. The plants are tufted, mat-forming, with a fleshy rootstock; leaves are green, smooth, crowded, 3-angled, up to 130 mm long, punctate often naviculate at the leaf-end. The flowers are borne on a branching cyme, the pedicels with ensheathing bracts, petals yellow, reddish below, opening in late afternoon, some being nocturnal. The capsule is 5-locular, with broad keels, stiff covering membranes and very large undivided sills which function as closing bodies.

Machairophyllum Schwantes: The distribution looks like an extension of *Bergeranthus* into the Western Cape, through the Little Karoo to Barrydale. The description tallies with that of *Bergeranthus* in most respects, differing only in that the closing bodies are small and deeply set, and the capsule may have more than five locules. The unrevised genus has 10 species, eight of these by L. Bolus. The linear-lanceolate leaves can be exceptionally long, and are glossy grey or white, seldom green, but the clumping or mat-forming habit resembles that of the related genus, *Bergeranthus*.

Rhombophyllum (Schwantes) Schwantes: Western region of the Eastern Cape Province. In a review of the genus under *New combinations in Ruschioideae* (Bradleya 16, 1998) Hartmann delimits five species. In her key, three species have leaves bilobed in the vertical plane: *R. dolabriliforme* is recorded on weathered sandstone in Albany and the eastern karoo from Willowmore to Graaff-Reinet. It forms low, rounded shrubs, branching apically, the leaves hatchet-shaped, dark green, dotted, up to 30 mm long; flowers mostly solitary. *R. dyeri* (*Hereroa dyeri*) of Albany is compact, up to 70 mm tall, leaves anisophyllous with a hump on the keel and up to 50 mm long, smooth or with raised dots, flowers in cymes. *R. nelii* has a karoo distribution from Steytlerville to Graaff-Reinet; its leaves are greyish-green, rough with raised dots, and up to 20 mm long. The two species which do not have bilobed leaves are: *R. rhomboideum* in the vicinity of Port Elizabeth, a stemless, clumping species with naviculate (boat-shaped) green leaves with white margins, and flowers in tall

cymes. *R. albanense* from Albany district is tufted to a height of 100 mm, leaves trigonous or nearly finger-like, to 15 mm long, flowers solitary, and grows on Ecca shales with *Euphorbia*. In *Rhombophyllum* the 5 nectar glands are distant, the top of the capsule has high rims, the covering membranes have a closing ledge which meets the flat spongy closing body, which is bilobed. It is the bilobed character of the closing body which separates *Rhombophyllum* from *Hereroa* which has a small closing body or none at all, and *Bergeranthus*, which has a broad undivided sill as a closing body.

Hereroa (Schwantes) Dinter & Schwantes: The unrevised genus shows an interrupted distribution in every province of South Africa (except the eastern Kwazulu-Natal and Mpumalanga) and Namibia, and is obviously made up of diverse elements. At present 32 species are listed. Habit varies from cushion or mat-forming to shrublets compact to 70 mm or branching to 300 mm. Diversity is greatest in the Western Cape, there being few in the Eastern Cape, one in the Free State and three to four in Namibia. No more can be said until the genus is revised in relation to all other genera in this group.

Bijlia N.E.Br. [colour p. 41]: Near Prince Albert which lies north of the Swartberg Mountains, in the Great Karoo. (There is current misconception as to what physiographic region Prince Albert occupies; it does not lie in the Little Karoo, which is south of the Swartberg Range.) The old name *Bijlia cana* is an incorrect name as Hartmann discloses in *Cact. & Succ. J. (US)* 64 (1992). The new name is *Bijlia dilatata* Hartmann, referring to its broad leaves. It differs from a second species, *B. tugwelliae* in having unequal leaves in a leaf pair, these being obliquely and clavately trigonous; in *B. tugwelliae* the leaves are almost similar, narrow, naviculate and chinned. The two species are adjacent but not overlapping in the Prince Albert district. The plants produce 2-3 branches in small to large clusters, with yellowish or whitish-green smooth leaves, up to 50 mm long; the yellow flowers shortly pedicellate, bracteate, up to 40 mm in diameter, appearing from April to June. The capsule is persistent, 5-locular, with high valve rims, covering membranes present with big hooked closing bodies.

Cerochlamys N.E.Br. [colour p. 42]: Western Cape: Calitzdorp to Oudtshoorn in the Little Karoo, Laingsburg in the Great Karoo and Swellendam in

the coastal belt. Up to 1998 the well known *C. pachyphylla* which grows, tufted, in between boulders on the southern foothills of the Swarberg particularly in the vicinity of Calitzdorp, was monotypic in this genus. Its succulent leaves up to 30 mm long are keeled and chinned apically, the keel rounded lower down; the outer layer having a deposit of calcium oxalate crystals and thick plates of wax. It has pink, white-centred or white flowers, flowering in June. In *Bradleya* 16 (1998), Hartmann adds *C. trigona* (an earlier synonym of *C. pachyphylla*) on the grounds of separated, narrower petals, but it is unlikely that these two are different. But, Hartmann points out that *Cerochlamys* has no capsular valve wings, also lacking in *Ruschia*, and has no closing bodies, also absent in *Lampranthus*. In this context she moves two species into *Cerochlamys*, namely *C. gemina* (*Ruschia gemina*) a plant with 6 calyx lobes and occurring near Laingsburg, and *C. purpureostyla* (*Erepsia purpureostyla* which was known by the illegitimate name, '*Ruschia forficata*'). Subsequent to this, it has been shown by Burgoyne (in *Aloe* 35(2), 1998) that the latter name and synonyms have been wrongly applied from the beginning, as the specimen concerned is a member of *Acrodon*, now correctly named *A. purpureostylus* (L.Bol.) Burgoyne (refer to Group 2.10, *Acrodon*).

Carruanthus (Schwantes) Schwantes [colour p. 39]: Willowmore which lies near the boundary of Eastern and Western Cape Provinces. Small, tufted plants up to 100 mm, crowded, yellowish-green leaves which are 3-angled, broadening at the apex with the keel chinned, margins often dentate, unlike the smooth margins in the rest of the group. Flowers are yellow, solitary or in cymes, the pedicel up to 100 mm, with ensheathing bracts. The capsule is 5-locular, valve rims very high, the covering membranes and closing bodies reduced or missing. There are two species: *C. ringens* which flowers in late winter and prefers a shaded locality, and *C. peersii* which flowers from September into summer and is found in exposed places.

2.9 Lampranthus Group

Ten of the twelve genera listed are monotypic or small, only three of these have been recently worked on. *Erepsia* is a larger genus which was revised in 1989 and the very large genus *Lampranthus* is presently under revision. The species are

shrubs up to 400 mm in height, rarely tufted or creeping. The leaves are free and not strongly xeromorphic, the crystal layer sparse or absent. Nectaries are separate or joined, covering membranes are complete with extra closing devices, endocarpal closing bodies nearly always absent, sterile funicles block the seed exits. Twelve genera are included here: *Enarganthe*, *Namaquanthus*, *Wooleya*, *Smicrostigma*, *Antegibbaeum*, *Braunsia*, *Esterhuyseia*, *Scopelogenia*, *Zeuktophyllum*, *Carpobrotus*, *Erepsia* and *Lampranthus*.

Enarganthe N.E.Br.: ('shining flower') Richtersveld. *E. octonaria* is monotypic, an erect, woody shrub to 180 mm tall with opposite entire leaves joined at the base and up to 35 mm long, club-shaped, blunt-tipped, fleshy and trigonous. The flowers are solitary or in threes, violet-red with 4 unequal sepals; the capsule is 8-locular, with covering membranes and closing bodies, the expanding keels parallel and diverging at their tips. In an early description of this species (*Mesembryanthemum octonarium*) L. Bolus wrote that the flower was strikingly beautiful, remaining open for several days and increasing its diameter to 70 mm, and that the brilliant rose-purple petals defied description. The plants flower in winter, opening at noon.

Namaquanthus L.Bol.: ('flower of Namaqualand') Another monotypic genus which occurs in the dry western winter rainfall region, this time north-west of Springbok. *N. vanheerdei* is a squat, sturdy shrub up to 300 mm tall, its branches covered with bluish-green, finger-like leaves about 60 mm long, 15 mm thick, and the remains of dead leaves. The bright pink to purplish flowers are 50-60 mm. in diameter with 4 unequal sepals, pedicellate with 2 bracts, nectar glands pink and in a ring. The capsule is 8- to 12-locular with covering membranes, closing bodies absent. Flowering in winter, the flowers are open the whole day.

Wooleya L.Bol. (*Namaquanthus farinosus*): Recorded from Port Nolloth, Hondeklip Bay and Kleinsee on the Namaqualand coast. The only species, *W. farinosa*, is an erect to sprawling shrublet to 300 mm tall, the ash-grey leaves obscurely keeled and end bluntly, about 35 mm long and covered with a powdery bloom. Flowers are white, solitary with 4 sepals; the capsule is 11- to 12-locular, the winged valves open out on wetting, covering membranes are well-developed and closing bodies are absent.

Smicrostigma N.E.Br.: The only species, *S. viride*, occurs in the Little Karoo and Robertson Karoo areas of the Western Cape. This is a small shrub up to 400 mm, becoming woody, recognisable by the opposite leaves which are narrowly united and completely sheath the narrow stem for 20–25 mm, with short trigonous leaf-ends, terminating in a reddish recurved spine. The solitary, terminal flowers are pink, thickly petalled with numerous staminodes and 20 mm in diameter; the stigmas, as its name reveals, are minute. The capsule is 7- to 10-locular, the valves wingless or with narrow wings, the keels with awned tips, the loculi are covered, without closing bodies. The plants flower in spring; once open, the flowers do not shut again.

Antegibbaeum Schwantes ex Weber [colour p. 42]: South-western Karoo. A monotypic genus which has very large flowers. *A. fissoides* branches to form leafy clumps about 80–100 mm high in which the leaves (slightly unequal in a pair) are about five times longer than broad and end bluntly. The reddish-violet flowers are up to 60 mm in diameter, on short pedicels with two pairs of floral bracts which distinguish it from *Gibbaeum*. The capsule is 6- to 7-locular, the expanding keels parallel but separate, with broad wings, covering membranes present with no closing bodies.

Braunsia Schwantes [colour p. 42]: South-western Cape and southern karoo. An interesting but unrevised genus of five dwarf species which are woody with erect or prostrate stems. The paired opposite leaves are joined for a quarter to half of their length, and the pale margins are cartilaginous, horny or translucent. *B. apiculata* is so-named because its leaves end in a sharp, dry point; the whole plant is velvety, 200 mm tall and has pink flowers. *B. stayneri* of the Ceres Karoo has creeping stems 150–300 mm long. *B. vanrensburgii* which grows in the Bredasdorp district is prostrate with short, erect branches and large white flowers up to 50 mm in diameter. The capsule is generally 5-locular, the covering membranes well-developed or reduced, closing bodies absent.

Esterhuysenia L.Bol.: Western Cape: Robertson-Worcester and Ceres Karoo, also Caledon in the coastal belt. The genus was set up by L.Bolus in 1967 for plants discovered by the life-long botanist and mountain climber, Elsie Esterhuysen, who found them on Milner Peak in the majestic Hex River Mountains north of Worcester. Low-growing

compact shrubs to 300 mm, in one species with hanging stems, often associated with cliffs and high ground, at more than 2000 m, in winter rainfall region. Leaves are trigonous to terete, mucronate, yellowish dark green. Flowers solitary, purplish-pink with bracts on the pedicel, nectaries ring-like or separate. The capsule is 5-locular, valve wings narrow, and withering later, expanding keels divergent, covering membranes present, in all but one species closing ledges are present, no closing bodies. The genus lacks the broad valve wings of *Lampranthus* and the closing bodies of *Ruschia*, two large genera which have 5 locules (Hartmann in *Bradleya* 16, 1998). The first description indicated absence of closing body and valve wings. Later investigation by Liede has proved that the capsules of *E. alpina* do have narrow valve wings; this new information allows for the transfer of several species from *Ruschia* into *Esterhuysenia*. In Hartmann's review of the genus (*Bradleya* 16, 1998) three new combinations are added, with excellent comparative sketches of the capsules. In a short key Hartmann distinguishes *E. drepanophylla* (*Ruschia drepanophylla*) as an erect shrublet to 150 mm; young stems tetragonous; it has no valve wings and no closing ledges; it occurs in the Ceres area. *E. alpina* with leaves less than 10 mm long (its dark green firm leaves have a 'fat mucro') and *E. inclaudens* (*Ruschia inclaudens*) with leaves 13–20 mm are distinguished as cushion-shaped low shrubs. *E. stokoei* (*Ruschia thomae*) grows on shady cliffs with pendent stems in the Caledon-Worcester area; the grey leaves slender, falcate, only 3 mm thick.

Scopelogena L.Bol. ('child of the rock'): A good name for these compact to mat-forming plants which grow on rocky sandstone cliffs and slopes in the Western Cape. In unrevised state there are two species: *S. veruculata* which grows on the mountains of the Cape Peninsula, erect up to 300 mm, with crowded, soft, light-green leaves 35 mm long and small yellow flowers in terminal cymes, with leaf-like bracts. *S. gracilis* is a low, spreading species in the Swellendam and Riversdale districts. The capsule is 5-locular, valve wings are absent, keels are divergent, covering membranes present but short, with no closing bodies. Once opened, the capsule does not close again completely. The flowers are scented and appear in October.

Zeuktophyllum N.E.Br.: Southern Western Cape. A small woody-stemmed shrublet about 100 mm tall, its branches densely covered by paired oppo-

site leaves united at the base, 3-angled, glabrous, hard, 20-30 mm long, young leaves greenish-purple. The flowering stems higher than the rest, the flower solitary, on a short pedicel, surrounded by the two bracts which resemble foliage leaves. The capsule is 8- to 9-locular, covering membranes complete or reduced. In *Bradleya* 16 (1998), Hartmann describes the confusion surrounding the type material from which Brown described the monotypic *Z. suppositum*, and she transfers *Z. calycinum* (*Ruschia calycina*, *Octopoma calycinum*) into the genus, although this species has covering membranes and in *Z. suppositum* they are very narrow or absent. The two species agree as to leaf structure, but differ in that the capsular keels of *Z. suppositum* extend right beyond the valve edge, whereas in *Z. calycinum* they scarcely do. Localities are not precisely given and rediscovery of fresh material of *Z. suppositum* is required for certain diagnosis.

Carpobrotus N.E.Br. [colour p. 42]: Widely distributed along the South African coastline with some inland species. There are seven South African species of *Carpobrotus* of which Wisura & Glen gave an account in 1993 (*Contrib. from Bol. Herb.* 15). Creeping succulents with prostrate stems and fleshy, erect, 3-angled leaves. The inferior ovary is 10- to 16-locular, the fruit indehiscent and without valves, becoming fleshy and often edible. *Carpobrotus* ('edible fruit') is well known and widely distributed from Namaqualand to the Cape Peninsula and eastwards to Natal, mainly littoral and found extensively on sand dunes. The common names 'sour fig' and 'Hottentot fig' are used in South Africa where several species are favourites of children and housewives: *C. deliciosus* from the south-western Cape is sweet and eaten fresh, while *C. edulis* is a sour variety often used in jams. The latter species has been used extensively as a sand-binder along the Natal coast. The flowers of these interesting 'vygies' average 60 mm in diameter and are pink to purple in colour. Exceptions are the yellow-flowering form of *C. edulis* and the white to deep-pink giant flowers (130 mm in diameter) of *C. quadrifidus* of Namaqualand, reputed to have the largest flowers in the Mesembryanthema. There are about six exotic species described, all of them littoral in Australasia, Chile and California. Much of its distribution abroad is probably due to introduction and naturalisation. It has several features which encourage its export: it is a large, handsome genus which grows quickly, covering and holding

earth banks, it is coastal and available. On the other hand, it is a unique mesem in several important ways and may have a natural overseas distribution.

Erepsia N.E.Br. (*Kensitia*, *Semnanthe*): Mainly in the south-western Cape winter rainfall region. The genus was revised by Liede (*Beit. Biol. Pflanzen* 64, 1989) in which 26 species are recognised in four sections. Included are *Semnanthe lacera*, now *E. lacera*, a plant from the Stellenbosch mountains which has sharply 3-angled leaves in which margins and particularly the keels are serrated, and *Kensitia pillansii*, now *E. pillansii*, from Piquetberg, which has distinctive stalked spatulate petals, the innermost of which are centrally collected in a cone, covering the stamens. Characteristic is the hypanthium or concave receptacle of the fruit into which the staminodes and stamens bend (Hartmann in *Bradleya* 16, 1998). The plants are shrubby, up to 400 mm tall, leaves triquetrous (distinctly angled), mucronate, waxy; flowers solitary with white or pink petals, nectaries in a ring or separate. The ovary is deeply recessed, the capsule has 5-10 locules, covering membranes are short with a distinct closing ledge. Hartmann in 1998 added a new combination, *E. aristata* (*Ruschia aristata*) and devised an amended key to the section *Crassifoliae* to include the extra species. *E. aristata* lies well outside the distribution area, at Uitenhage, in the Eastern Cape.

Lampranthus N.E.Br. [colour p. 42] ('bright flower'): Most species of this large genus occur in the Cape Peninsula-Piquetberg-Clanwilliam area, decreasing towards Caledon and Bredasdorp in the east and Namaqualand in the north; very few species occur in the Eastern Cape, and possibly two species in Namibia. Erect to creeping shrubs, the stems often reddish, paired leaves are free or only slightly joined. The flowers are medium to large, up to 60 mm across, and so placed that the entire bush often becomes one shining bright colour, in red, pink, mauve, yellow, orange or white; this character, and because sections of stem root easily, has made this genus the best horticultural item among the mesems. The capsule is 5-locular with large valve wings, covering membranes complete, often with rodlets or closing ridges but true closing bodies (from the endocarp) are missing. Hartmann (*Bradleya* 16, 1998) has added six new combinations and four new names to the species list. The new combinations are: (not all the synonyms are given here) *L. amphibolius* (*Ruschia amphibolia*),

L. curviflorus (Haw.) Hartmann (*L. curviflorus* (Haw.) N.E.Br. ex Jacobsen), *L. dissimilis* (*Ruschia dissimilis*), *L. marginatus* (*Ruschia marginata*), *L. mutatus* (*Ruschia mutata*) and *L. profundus* (*Ruschia profunda*). New names are: *L. arenarius* (*Ruschia arenosa*), *L. francesiae* (*Ruschia leightoniae*), *L. pakpassensis* (*Ruschia pakhuisensis*) and *L. tanquanus* (*Ruschia salteri*). The revision of *Lampranthus*, *Ruschia* and allied genera continues.

Note: While the above combinations and new names were in press *Lampranthus tanquanus* (*Ruschia salteri*) was transferred to a new genus as the type species: *Hammeria salteri* (L.Bol) Burgoyne (*Cact. & Succ. J. (US)* 70); no comparison with *Lampranthus* was made. Subsequent to this, a new combination, *Hammeria meleagris* (L.Bol) Klak, has been published for this species in *Bothalia*, 2000.

2.10 *Ruschia* Group

Usually erect shrubs from 250 mm to 3.5 m, rarely prostrate or trailing, less often low, tufted or mat-forming succulents. Leaves free to joined, surfaces homocellular and xeromorphic, with crystal layer, capsule with firm covering membranes and small to medium closing bodies, often with other closing devices, rarely nutlets.

- Dwarf, clumping or mat-forming succulents: *Acrodon*, *Ebracteola*, *Khadia* and *Marlothiella*.
- Shrubs, erect to trailing: *Amphibolia*, *Eberlanzia*, *Astridia*, *Polymita*, *Arenifera*, *Ruschia*, *Ruschianthemum*, *Stoeberia* and *Stayneria*.

Acrodon N.E.Br.: Southern Cape and Little Karoo. Glen (*Bothalia* 16(2), 1986) regards *Ruschia* species as typically shrubby plants with flowers in cymose inflorescences, and thereby distinguishes the dwarf, clumping or mat-forming *Acrodon* in which the internodes are often hidden by the 3-angled, toothed or smooth-angled green leaves. Two of his four species are recognised in the later review of *Acrodon* by Hartmann in 1996: *A. bellidiflorus* (*A. duplessiae*) which is quite common and extends from Hermanus to Oudtshoorn, and *A. parvifolius* which is coastal. Hartmann adds *A. subulatus* (*A. leptophyllus*) which, like *A. bellidiflorus*, grows in shaded renosterbos veld, and a new species, *A. quarcicola* which lives exposed on quartz slopes in the vicinity of Cape Agulhas. The new species is compact, with scimitar-shaped leaves up to 20 mm long, the angles with small teeth which are lost in the older leaves. A fifth species is *A. purpureo-*

stylus which is moved from *Cerochlamys* (see Group 2.8, *Cerochlamys*) into *Acrodon*: this grows between Bonnievale and Stormsvlei; its flowers are 17-20 mm across, on bracteate pedicels up to 80 mm, the flower is scented and (like the other species) the petals are median-striped. In *Acrodon* the flowers are white to pink, the capsule has 5 deep locules, open valves are almost erect, no valve wings, complete covering membranes, and large closing bodies. The species are all similar in appearance, but *A. parvifolius* has short capsules, which are thicker in *A. quarcicola*, and longer in *A. bellidiflorus* and *A. subulatus* (Hartmann 1996).

Ebracteola Dinter & Schwantes [colour p. 42]: The four species have separate areas: *E. derenbergiana* on desert flats in south-western Namibia, *E. montis-moltkei* on quartzite slopes in Damara-land in central Namibia, *E. fulleri* south of the Orange River in Bushmanland, and *E. wilmaniae* further east in the northern interior of the Cape Provinces, northern Free State and Gauteng. These are dwarf clumping succulents with enlarged root-stock, and shortened stems bearing glaucous dark-dotted leaves, terete to trigonous and pointed, 30-40 mm long. Flowers are solitary or in cymes of two or three flowers. Glen (*Bothalia* 16(2), 1986) finds floral bracts present in some species but missing in *E. derenbergiana* and *E. montis-moltkei*. Hartmann (*Bradleya* 14, 1996) distinguishes between bracts and bracteoles and illustrates the bracteoles in *E. derenbergiana* (*E. candida*), stating that "all fruits examined show bracteoles on their pedicels". In *E. wilmaniae* and *E. montis-moltkei* the capsule has a rounded base, in *E. fulleri* and *E. derenbergiana* the capsule is funnel-shaped. Flowers are pale pink, magenta or white, and up to 30 mm across. The capsule is woody, persistent, 5-locular, with covering membranes, narrow valve wings, closing ledges and variable closing bodies in the examples shown. Details of the four species are not given in the 1996 circumscription.

Khadia N.E.Br. [colour p. 42]: The five species of *Khadia* all occur at higher altitudes of above 1400 m on the Soutpansberg, Steenkampsberg, Magaliesberg and Witwatersrand in north-east South Africa. The only other mesems in this region are the long-ranging *Delosperma*, *Lithops* (three species) and *Frithia* (Chesselet et al. in *Bothalia* 28(1), 1998). Dwarf, compact to mat-forming, only one species has long trailing stems while the rest have short internodes. The leaves are triquetrous (sharp-

ly 3-angled) but almost round below, green or glaucous with clear dots concentrated on all margins. Flowers solitary with pedicels, pink, rarely white, flowering in summer. Capsule persistent or shedding and forming a tumble fruit; top raised or flat, valves without wings but with raised rims, covering membranes complete, the closing body reduced to a bud of placental origin, or an outgrowth of the expanding sheet over a protuberance from the ovary wall. The number of locules vary from 8-10 in *K. acutipetala* (Gauteng); 5-7 in *K. borealis* (Soutpansberg) which exhibits rhizomatous growth, and 6-locular in the other three species: *K. beswickii* (on east Rand in Gauteng); *K. alticola* (Mpumalanga and KwaZulu-Natal); and *K. carolinensis* near Carolina in Mpumalanga which has white flowers and large closing bodies. In the 1998 revision the capsules are drawn by Chesselet, excepting for *K. beswickii*, the habitat of which is possibly destroyed by human settlement, also the plants may have been harvested to extinction for the making of beer, 'khadi', from the roots. This name is also known in eastern Zimbabwe, suggesting a wider distribution for the genus.

Marlothiella Schwantes: Little Karoo and Prince Albert in the Great Karoo. In 1995 *Marlothiella* was reinstated by Hammer to take up a single species, *M. stenophylla*, a transfer out of *Ruschia*. The plants have a low tufted habit and a characteristic deep rootstock. Leaves are more or less terete, short to long, soft, and taper to a point. Flowers are pedicellate, purple, with whitish centre, the petals with a median stripe and filaments centrally collected. The flowers appear in winter and are diurnal. The capsule is 5-locular with stiff covering membranes and large closing bodies.

Amphibolia L.Bolus: Coastal from Lüderitz Bay in Namibia to the end of the Cape Peninsula, but extending inland to some degree in their northern distribution. In *Bradleya* 16 (1998) Hartmann presented further re-arrangement of taxa within the *Ruschia* Group, and this radically alters the composition of *Amphibolia*. Only one of the species originally under *Amphibolia*, namely *A. rupis-arcuatae*, fulfills the requirements of the genus, the rest become synonyms under *Lampranthus* and *A. hutchinsonii* as follows: *A. gydouwensis* = *Lampranthus gydouwensis*; *A. hallii* = *L. amphibolius*; *A. littlewoodii* = *L. mutatus*; *A. stayneri* = *L. dissimilis*; *A. maritima* = *Amphibolia hutchinsonii*. *Amphibolia* is described as being a shrub up to 400

mm tall with decumbent branches. The leaves are club-shaped, soft, with flat waxy epidermis. Flowers are terminal, usually in threes, white or pinkish with median stripe, filamentous staminodes present, stigmas purple, capsule whitish, with long funnel or bell shape, the tops flattish with low rims, expanding keels divergent, broad valve wings, covering membranes with closing rodlet or ledge, and small hook-shaped closing bodies. Hartmann recognises five species: *A. obscura* Hartmann is a new species from the lower reaches of the Orange River, in habitat the plants are well separated, up to 400 mm tall, bright green, leaves 15-45 mm long, flowers white with petals separated into five groups, the capsule 6-locular. *A. rupis-arcuatae* extends from Lüderitz to Kleinsee in Namaqualand. It is erect and compact to 500 mm, flowers often solitary, petals white with a dark stripe, filamentous staminodes purplish above, stamens white, the capsule 5-locular, with small hooked closing bodies. *A. hutchinsonii* (*Ruschia hutchinsonii*, *A. maritima*) is coastal from Strandfontein west of Vredendal to Simonstown. It is shrubby from 200-400 mm, branches becoming decumbent and rooting, leaves light green or yellowish, flowers pale pink, capsule 5-locular with closing rodlets at the end of the covering membranes. *A. saginata* (*Ruschia saginata*) occurs on the Klinghardt Mountains in southern Namibia. It is similar to *A. hutchinsonii* and *A. succulenta* but is distinguished by its thicker leaves which are almost round, 10-20 mm long, nearly 12 mm broad and thick. The capsule is 5-locular with closing ledges at the end of the covering membranes and closing bodies very small. *A. succulenta* (*Ruschia succulenta*) occurs from the Orange River to Hondeklip Bay. Again shrubby to 400 mm, the narrow leaves greyish-green, petals purplish, with a white band, capsule 5-locular, covers with closing ledges or rodlets, the closing body a small hook.

Eberlanzia Schwantes: Distributed from north of Lüderitz in Namibia to the north-west of Namaqualand, on desert sand flats with very low winter rainfall and Atlantic fog. The genus at first contained 28 species with spines; from 1993 study of the group revealed that 27 of the species belonged in other genera, mostly in *Ruschia*. *Eberlanzia* sensu stricto has blunt spines which break easily and are the remains of old pedicels (Hartmann in *Bradleya* 16, 1998). The plants are erect to 500 mm or procumbent, with grey to white internodes. The leaves are almost free, greyish to dark green, mucronate, papillate and waxy. Flowers many to few

in bracteate inflorescences, pedicels sometimes becoming spiny, petals may be absent, staminodes in a cone, capsule 5-locular, valve wings broad, tapering at the ends, covering membranes with closing rodlet, and closing bodies small. Hartmann keys out eight species, six of these being new combinations, dividing them into those with more than 20 petals, and those without or with fewer petals. The petalled species are: *E. dichotoma* (*Ruschia dichotoma*) which has 'rich cymes' of purple flowers, *E. ebracteata* (*Ruschia ebracteata*) white to pale pink, and *E. cyathiformis* (*Ruschia cyathiformis*) with pink cymes well above the 400 mm tall shrub. *E. cyathiformis* forms yellowish, orange or red 'cushions' (leaf colour) with white internodes which are conspicuous in habitat in north-western Namaqualand and south-east of Lüderitz; *E. parvibracteata* (*Ruschia parvibracteata*) of Namaqualand has cymes of pinkish-purple flowers. The better known *E. sedoides* is spiny with no petals, the closely related *E. clausa* is very spiny and also lacks petals. In summary, 20 species of *Eberlanzia* have been placed in *Ruschia*, and 6 *Ruschia* species have been added to *Eberlanzia*. The shift backwards and forwards from *Ruschia* may be confusing to many, but it must be remembered that taxonomy is a complicated science governed by a code, and that decisions taken can be modified by the next 'new' specimen that arrives on the work bench.

Astridia Dinter [colour p. 42]: Southern Namibia and the Richtersveld. The genus is named after Mrs Astrid Schwantes. Robust, erect shrubs to 600 mm tall, with internodes visible. The greyish-green leaves are almost terete but with subangular appearance, 30-60 mm long, forming a short sheath at base, and apically abruptly pointed, velvety. Flowers solitary or several, on short pedicels and large, up to 70 mm across, in a variety of colours: white, yellow, pink, mauve and red, summer-flowering. *A. citrina* is the only yellow-flowered species; *A. speciosa* has the largest flowers, but several other species are very close to it. The fruit has conspicuous raised rims, the capsule is 6-locular and of the *Ruschia* type, having no valve wings, and with well developed covering membranes and closing bodies. The genus was revised by Glen (*Bothalia* 16(2), 1986) who reduced the species from 16 to 7.

Polymita N.E.Br.: Northern Namaqualand. Shrubby up to 400 mm, the leaves united for half their length forming a stem-clasping sheath, with point-

ed tips spreading; the margins and keel horny. The scented flowers appear in summer, white with thread-like petals which tend to arrange into five groups, filaments white and centrally collected. The capsule is hard with a high white top, mostly 9-locular, the base funnel-shaped, valves with broad wings which distinguishes it from *Schlechteranthus* which is similar, and round closing bodies. There are two species: *P. albiflora* has the larger, more eastern distribution, the leaf is sharply mucronate, the margins serrate, the capsules have large white closing bodies. *P. steenbokensis* Hartmann was published in *Bradleya* 14 (1996), it has a small isolated position to the west of *P. albiflora* on southern slopes. The leaves have small apical teeth which break off, the leaf angles are almost rounded, and the capsular closing bodies are small and dark.

Arenifera Herre: From the Richtersveld southwards to Calvinia, and from the Knersvlakte to Matjiesfontein in the Western Cape. Originally described as *Psammophora pillansii* by L. Bolus in 1927, this species was made a monotypic genus by Herre in 1948. *A. pillansii* is an erect shrub to 250 mm tall, the leaves green and viscid when young, becoming glaucous later, covered with sand and dust which does not flake as in *Psammophora*. There are important differences between it and *Psammophora*: the flowers are ternate (in threes), pink, noon-opening; the capsule is 8-locular, with complete covering membranes and closing rodlets as well as closing bodies. In addition, the sticky glue on the leaf surface apparently has a different origin to that of *Psammophora*. In *Bradleya* 14 (1996), Hartmann reviews *Arenifera* and adds to it two new combinations from *Ruschia* and a new species, *A. pungens*, which extends from south of Steinkopf to Calvinia. The new members are shrubby up to 400 mm and do not have sticky leaves. They are all spiny species, *A. pungens* having the densest spine cover of all, its spines brittle and acute. The other two are *A. spinescens* (*Ruschia spinescens*) and *A. stylosa* (*Ruschia stylosa*). This enlargement of what was a monotypic genus is based on fruit characters. Hartmann's illustration of the four capsules shows the relationship, with the notable difference that *A. pillansii* has broad rectangular valve wings which are absent, or nearly absent, in the new members.

Ruschia Schwantes [colour p. 42]: Covers southern Namibia and most of South Africa with the exception of the eastern regions; greatest species diver-

sity is in the drier western winter rainfall areas. When Schwantes described the genus it consisted of 18 species. Today 423 species names are available (Hartmann 1998). Counter-action came with Dehn's revival of the genus *Antimima* in 1989, when he discovered that at least 100 species of *Ruschia* differed from its typical forms. Since then there has been a policy of transferring species out of this large assemblage. One hopes that this will not make the species that remain a more unnatural group than they were before (read 'dustbin taxa', pp 108-109 in *Principles of Angiosperm Taxonomy*, Davis & Heywood 1963). Since no stable list of species is available for *Ruschia* at present, it seems best to summarise the differences between these important categories, as given by Hartmann in *Bothalia* 28(1), 1998 (see Table 1).

Many *Ruschia* species have been transferred to *Acrodon*, *Amphibolia*, *Antimima*, *Ebracteola* and *Eberlanzia*, leaving over 200 species in *Ruschia*. In *Bradleya* 14 (1996), Hartmann described a new species, *Ruschia scabra* which extends across the upper western karoo; this had been lodged as a form of *R. muricata*, from which it is now distinguished; both belong to a muricate (warty) leaved complex in the genus.

Ruschianthemum Friedrich [colour p. 42]: Confined to a small desert area on both sides of the Orange River mouth from the Klinghardt Moun-

tains in Namibia to the Richtersveld. In his description, Herre (1971) notes that these woody erect shrubs up to 1.2 m are similar in appearance to *Stoeberia*. The single species is *R. gigas*. The leaves are succulent, decussate, obscurely 3-angular especially near the tip. The small flowers are many, in much-branched terminal cymes; the petals whitish, staminodes and stamens thickly conical. The capsule is 5-locular and immediately distinguishes the species from other mesems by breaking up into nutlets at maturity. There are only one or two seeds in each locule, the large closing body taking up the rest of the space. When the seeds are shed the empty capsule takes on a unique, sand-blown skeletonised appearance.

Stoeberia Dinter & Schwantes: Along the west coast and mountains, from southern Namibia to Elands Bay in the Western Cape. In Friedrich's revision of the *Stoeberiinae* in 1960, three taxa of *Stoeberia* were recognised and the new genus, *Ruschianthemum*, was set up. In *Aloe* 31 (1994) Van Jaarsveld gives a clear, mainly morphological description of the *Stoeberia* complex; unfortunately, few details and no diagrams of the capsules are given. *Stoeberia* is remarkable for its great size (one species being taller than a man), and also has some of the smallest flowers in the mesem family. The new species, *S. arborea* Van Jaarsveld occurs on mountainous terrain from Rosh Pinah in Nami-

Table 1. Differences between the genus *Ruschia* Schwantes and the genus *Antimima* N.E.Br.

<i>Ruschia</i> Schwantes	<i>Antimima</i> N.E.Br.
Growth form Growth form shrubby to prostrate, described as 'creeping', branching at distal end.	Compact to tufted, often with long shoots, not branching distally.
Leaves Leaves isophyllous (all leaves about equal)	Isophyllous and heterophyllous (leaves unequal). Hartmann deduces that heterophylly is correlated with the <i>Antimima</i> -type capsule.
Flowers Flowers are small in both genera, petals white, pink or purple, often arranged in groups. Inflorescences likewise do not differ, flowers solitary or in cymes in both genera.	
Fruits	
1 Locule numbers are mostly five in both genera.	
2 Small hook-shaped closing bodies, not really effective.	Large closing bodies which block the distal exit of seeds.
3 Both genera exhibit additional closing devices; both genera mostly lack valve wings.	
4 Expanding keels are rather short, in open capsule the valves erect only.	Expanding keels long, nearly reaching the tip of the valve. The valves usually open fully.
5 The capsule has a deep base.	The capsule is shallow, bowl or funnel-shaped.

bia to Bitterfontein in the Western Cape. This is a woody shrub up to 3.5 m tall, bluish-green leaves and white flowers in dense panicles. Hartmann (1996) recognises all species in the Van Jaarsveld synopsis, with the exception of the new *S. arborea*, suggesting it is a hybrid (unusual in the Mesembryanthemaceae) and describes a further new species, *S. porphyrea*, also of tree-like proportions, and gives a lively discussion of the merits and shortcomings of both new species. She calls it "an exciting aspect for further research" – and so it should be. A key to the five species uses seed characters and dimension only. *S. utilis* with small velvety leaves and erect to 2 m is a coastal species from the Orange River to Elands Bay in the south-west Cape. *S. frutescens* is a smaller shrub up to 1.5 m tall, with linear leaves, its purple-centred flowers 10–12 mm across, extending from southern Namibia to the Knersvlakte. *S. beetzii* (*S. apetala*) occurs in the Strandveld, from the Orange River to Hondeklip Bay; it is the smallest in the genus, up to 600 mm, with smooth, grey, clavate leaves. *S. carpii* is on both sides of the Orange in the Richtersveld area; it is different to the others, having drooping stems with large grey leaves, unusual large white flowers to 20 mm across. Capsule structure as illustrated by Hartmann shows a good deal of variation: closing bodies are present in *S. beetzii* and *S. frutescens*, which lack persisting funicles, while three other species lack closing bodies but have persistent funicles. The capsule is in fact, very different from that of *Ruschia*; once its capsule is open it stays open, and is adapted for wind dispersal of its seeds, the closing bodies which are either apparent or deeply hidden in the locules, are without a blocking function. The conclusion must be drawn that *Stoeberia* is not closely related to either *Ruschia* or *Ruschianthemum*. Several question marks hang over both modern treatments of *Stoeberia* taxonomy and a detailed revision is necessary.

Stayneria L.Bol.: A monotypic genus which honours Mr W.F. Stayner, ex-curator of the Karoo Botanic Garden, Worcester, and is located in the same district; it is present in the Breede River valley as far as McGregor. It was described by L. Bolus in 1961, and said to be closely allied to *Ruschia*, although differing in having 7–9 stigmas and capsules which expand repeatedly but do not close completely. The only species, *S. neilii*, (*Ruschia neilii*), is a vigorous, branching shrub up to 1 m tall, with paired, ascending, light-green leaves up to 70 mm long and less than 10 mm in width, acutely keeled

and joined at the base, sheathing the stem. The white to pink flowers are terminal and in threes, having bracts 20 mm long; the capsule is 6- to 9-locular, the covering membranes are well developed but closing bodies are absent.

2.11 Leipoldtia Group

Leaves free to joined, xeromorphic, with fine granular crystal layer; flowers with or without staminodes, with a nectary ring, the capsules multilocular, the covering membranes with closing ledges, bulges or rodlets at the distal end, with large (rarely without or small) closing bodies. Fifteen genera are included here: *Cheiridopsis*, *Odontophorus*, *Octopoma*, *Antimima*, *Argyroderma*, *Ottosonderia*, *Fenestraria*, *Cehalophyllum*, *Jordaaniella*, *Leipoldtia*, *Hallianthus*, *Pleiospilos*, *Vanzijlia*, *Schlechteranthus* and *Cylindrophyllum*.

Cheiridopsis N.E.Br.: From southern Namibia through Namaqualand to the south-western Cape and south of the Tanqua Karoo; its centre of dispersal lies in northern Namaqualand in the Steinkopf-Springbok area, where its nearest relative, *Odontophorus*, also occurs. Dwarf, tufted succulents with dimorphic leaf pairs (usually long and short) which have great variety of form. The plants range in size: *C. meyeri* (Steinkopf) is the smallest, *C. pillansii* with very fat leaves makes big clumps up to 500 mm in diameter (Richtersveld). In the sheath-forming species one leaf pair will desiccate into a papery cover for the resting stage. In *C. peculiaris* the leaf pairs take up two positions: one flat and



Cheiridopsis peculiaris

largely free, the second pair fused for more than half its length and upright, this pair passes into the resting stage. Other species, like *C. schlechteri*, do not have leaf sheaths, they shrivel; *C. pearsonii* (Khamiesberg) is thin-leaved and requires water all year, if deprived, the leaves wilt. Leaves often have translucent spots, as in *C. alata*. *C. aspera* is distinct because of the hard white projections on its leaf surface; *C. undausensis* is closely related but may have dentate leaf angles. The *C. aspera* complex is very close to *Odontophorus* and was placed in *Cheiridopsis* subgen. *Odontophoroides* Hartmann & Dehn. In 1987 the genus was revised by Hartmann & Dehn who examined the function of the leaf 'sleeves' and the significance of the horns and wings on the covering membranes. 23 species were recognised and placed in three subgenera. Since then six species have been described by Hammer and several 'lost' species have been re-encountered (Bradley 11, 1993) so that the species tally stands at 33 at present. Flowers are pedicellate, bracteate, usually yellow, sometimes white, rarely purple-red. *C. speciosa* and *C. purpurea* (which may be the same) have the rarely occurring red-magenta petals. Flowering is during the winter as the plants rest in summer. The capsule is multi-locular, with awned keels, covering membranes and large closing bodies. Different species often live together (sympatry) but hybrids seldom occur. Plants tend (Hammer 1993) to lose natural character in cultivation.

Odontophorus N.E.Br. [colour p. 42]: Northern Namaqualand, particularly in the Steinkopf area. The genus was revised in 1976 by Hartmann who recognised three species. It was reviewed by Hammer (Bradley 11, 1993) who recognises *O. herrei* and has since delineated a fifth species, *O. pusillus*. The plants form small clumps, or, in the case of *O. angustifolius*, substantial cushions up to 500 mm in diameter (Kosiesberg in the Richtersveld). The genus is characterised by the long papillae which give the greyish-green, 3-angular leaves a felty texture, and the strong marginal teeth. Flowers are solitary, sessile or pedicellate, petals yellow, often short and suberect, the capsule 8-11 locular, softly hairy, expanding keels toothed, covering membranes stiff, closing bodies large. *O. marlothii* (west of Springbok) has trailing stems up to 500 mm which bear flowers, unusual in a genus which has compact growth. *O. angustifolius* subsp. *protoparcoides* has been distinguished by the long blackish bristles on the leaf keel teeth and on the leaf

surface. The group is strongly related to *Cheiridopsis* subg. *Odontophoroides* Hartmann & Dehn.

Octopoma N.E.Br.: Namaqualand and southern Western Cape. Brown's description refers to low-growing shrubs 100-200 mm tall. The stem has short internodes, the short, smooth, opposite leaves are keeled and joined at the base, encircling the stem. The flowers are mainly pink to purple, the capsule 7- to 10-locular. According to Hartmann the genus contains two groups, in one the fruit resembles the *Leipoldtia*-type fruit, in the other its features are similar to the *Ruschia*-type fruit. The genus requires revision and its distribution needs to be defined. Two of its species (one of them, *O. octojuge*, is the type species; the other, *O. quadrisepalum* (L.Bol.) Hartmann is a new combination from *Ruschia*) are said to be from Ladismith (Little Karoo), Laingsburg (Great Karoo) and Swellendam (coastal region). The remaining six species are from Clanwilliam, Vanrhynsdorp, or just 'Namaqualand' (a vast area). Hartmann (Bradley 16, 1998) says that at least two genera are involved here. One of the species, *O. calycinum*, is transferred to the genus *Zeuktophyllum*.

Antimima N.E.Br. [colour p. 42]: *Antimima* in its present dimension presents an interesting distribution: most of its 100 species lie in the Namaqualand region, from the Orange River to Vanrhynsdorp (and Calvinia on the plateau), decreasing in the direction of Clanwilliam (about eight species) and Malmesbury (three) and only one at Saldanah Bay. They are sparse in Bushmanland and the northern region (about three species) and one in the Free State. About 14 species occur from Fraserburg southwards to Laingsburg and Riversdale, and only one near Willowmore in the Eastern Cape.

In 1996 Hartmann described a new species, *A. aurasensis*, from Namibia, one of about five species in that country.

In 1930 N.E. Brown described *Antimima* with one species, *A. dualis*, which looks rather like an *Argyrodema* and had been under that genus; it had also been described as *Ruschia dualis* L.Bol. In his research into *Ruschia*, Dehn (1989) found that not only *A. dualis* but about 100 species of *Ruschia* were incompatible with this genus, and so he re-instated *Antimima*, making only four new combinations, one of them, *A. virgata*, an erect shrub with triquetrous leaves and *Ruschia*-type fruits has been transferred back into *Ruschia* (Hartmann 1998). Hartmann has since transferred 95 species into *Antimima* (*Bothalia*

28(1), 1998). The differences between *Antimima* and *Ruschia* are dealt with under *Ruschia* in Group 2.10. This movement makes a far more natural arrangement. *Antimima* is generally a low-growing, compact, tufted plant making mats or cushions which may have long shoots; the leaves of a pair equal or unequal, naviculate to almost finger-like, often keeled near the tip, mucronate, waxed, in some, joined to form a protective sheath in alternate leaf pairs. Flowers solitary or several, pink to purple, staminodes centrally collected. The capsule is 5-locular, always with persistent bracteoles, base bowl- or funnel-shaped, covering membranes undulate, sometimes winged, closing body large, keels reaching to the tip of the valve. *Antimima* presents a very interesting, attractive group which deserves more attention. It has a wide variety of habit which explores the possibilities of the arid habitat it generally chooses: it would be fascinating to see a reference collection of them, which could facilitate further study. For example: why do several species smell of fish? Why do *A. lokenbergensis* and *A. komkanskica* attain shrubby heights of 450-600 mm?

Argyroderma N.E.Br. [colour p. 43] ('silver skin'): Restricted to the quartz fields in the Knersvlakte north of Vanrhynsdorp in southern Namaqualand. The Hartmann monograph on *Argyroderma* appeared in 1977. The previous 48 species were reduced to 10 species and one subspecies; since then a new species, *A. theartii* Van Jaarsveld has been published. *Argyroderma* is a solitary or clump-forming dwarf which produces two new greenish-white, waxy, smooth, unspotted leaves each season, the plant body either sunken or aboveground. The colour of the flowers – white, yellow or purple – is not an important distinguishing feature. There are two subgenera: subgen. *Roodia* in which there is only one species, *A. fissum*, which forms patches of green finger-like leaves which are quite different to the silver-grey, split-egg plant body found in the rest of the genus. Subgen. *Roodia* is less specialised than the rest of the genus and is considered by Hartmann to be primitive. In subgen. *Argyroderma* the plants are branched or unbranched, clustered or solitary, the whitish-green leaf-pair short, squat and obtusely rounded with a 'pebble' appearance, old leaves persisting or deciduous, the flowers terminal and more or less sessile. The leaf pair fissure has a varying gape, but is pushed apart by the emerging flower which has an hypanthium, it is this feature which distinguished *Antimima dualis* (in which the ovary has a flat surface) from *Argyroderma*. The

capsule has mostly 12 locules, less often up to 18 chambers; the covering membranes are rigid, the closing bodies large. The plants flower from April to June, suddenly revealing themselves in an unsuspected multitude. The following delightful description is given in *Mesembs of the World* (1998): "Beetles are fond of the flowers and sleep in them overnight". For those of us who know Namaqualand, this is a new (and cheaper) form of 'bed and breakfast'. For most people, identification of the species is difficult, the following notes may help: The sunken species are *A. crateriforme* in which the old leaves are deciduous, it is solitary or branched, with yellow flowers; *A. delaetii* is solitary, the leaves are deciduous, the flowers purple, yellow, white and rarely red in the same population. Two raised, solitary species are *A. pearsonii* in which the persistent leaves form a column and *A. ringens* which has a wide fissure, old leaves deciduous. Raised clustered species are: *A. congregatum* with yellow flowers; *A. patens* with wide fissure and strongly keeled leaves, purple flowers; *A. subalbum* with an almost closed fissure; *A. testiculare* with keeled leaves, narrow fissure, the old leaves persistent and column-forming, with purple flowers; *A. framesii*, very small-leaved with floral bracts spotted or reddish-brown; *A. theartii* in which the leaf pairs are up to 35 mm long, fused for two-thirds of their length, old leaves persistent. Positive identification requires a detailed study of time of flowering, locality, shape of the leaf pair and fissure, the position of the floral bracts and capsule characters.

Ottosonderia L.Bol.: Two species occur in Namaqualand. The genus is named after Dr Otto Sonder who was one of the editors of the *Flora Capensis*. The plant has short sterile stems 20-40 mm long which produce clustered green leaves up to 60 mm long. The erect fertile stems are up to 150 mm and produce a unique inflorescence: in the first year the flowering branch consists of a pair of shiny green leaves followed by 2 bracts and a solitary pink or purplish flower. In the second year, buds in the axils of the 2 bracts grow into 2 similar flowers; repetition of this results in a broad cyme, the old bracts persisting for a long time. The capsule is 6- to 8-locular, the valves without wings, covering membranes well developed and closing bodies large. According to Hartmann the fruit is most similar to the *Ruschia*-type, but the genus has *Leipoldtia* affinities. Not only is its placement uncertain but there is also doubt as to whether *O. monticola* and *O. obtusa* are

distinct species; certainly they occupy two small separate localities in Namaqualand.

Fenestraria N.E.Br. [colour p. 43]: On coastal desert from Lüderitz in Namibia to the southern side of the Orange River mouth in the Richtersveld. A monotypic genus which was revised by Hartmann in 1982. The name *F. aurantica* N.E.Br. was changed to *F. rhopalophylla* (Schlechter & Diels) N.E.Br. and the subsp. *aurantiaca* (N.E.Br.) Hartmann was set up. These are sunken dwarf plants with truncated, fleshy, windowed leaves which form patches or very low mounds in the sand, sustained by fleshy roots, and stems, which appear to be rhizomatous in Carter's illustration (*Genera of the Mesembryanth.* 1971), these giving rise to secondary rosettes of leaves. Subsp. *aurantiaca* has yellow flowers and occurs at the southern end of the range, entering South Africa. The typical subsp. *rhopalophylla* has white flowers and a much larger distribution, from Lüderitz to just south of 28° south. The flowers of both are long-pedicelled with many diffuse stamens; the capsules are 8-16 locular and break off, becoming tumble fruits. Covering membranes are well developed, valves have small wings and the closing bodies are small. The genus is related to *Jordaaniella* as far as the fruit type is concerned.

Cephalophyllum N.E.Br. [colour p. 43]: On sandy soils of the coastal regions from Lüderitz in Namibia to Saldanha Bay in the Cape, and extending from Malmesbury westwards across the karoo to Oudtshoorn. The long internodes connect tufts of leaves which are up to 80 mm long, the stem rooting at intervals. This little known genus is well worth cultivating, considering it produces some of the finest flowers known in the mesem family; their colours include gold, crimson, scarlet and apricot-red, often with spectacular coloured stamens, their size ranging to a remarkable 100 mm in diameter. Two deserve special mention: *C. alstonii* of Ceres has ruby-red petals and violet stamens, and is probably the most beautiful *vygie* of all. An erect species is *C. spongiosum* which has large scarlet flowers with yellow anthers. Both of these seem cautious about flowering in cultivation in countries other than South Africa, apparently the numbers of hours of sunlight is critical for them, and the provision of extra lighting in the northern hemisphere may bring them into flower. L. Bolus listed 79 species in seven groups; Herre (1971) mentions 63 species. In 1984 four species were extracted by Hartmann and constitute the genus *Jordaaniella*.

Cephalophyllum was revised by Hartmann in 1988 (*Mitt. Inst. Allg. Bot. Hamb.* 22). In her study she divided the genus into two groups, subgen. *Cephalophyllum* (nine species) in which the plant is long-leaved and produces annual short-leaved flowering stems, and subgen. *Homophyllum* (21 species) in which the leaves are of equal size. Since then *C. fullerii*, *C. hallii* and *C. spongiosum* have been included so the present number of species is 33. Two main characters are observed – the low, prostrate and tufting habit (good ground covers) and a brilliant kaleidoscope of colour. Hartmann (1988) produces an interesting distribution map of 'colour populations' in which yellow is predominant everywhere (and the only colour in Namibia); red and yellow petals abound in the vicinity of Springbok; *C. alstonii* is a handsome rare red near Ceres, and purple as well as yellow flowers occur in the southwestern Cape and across to the Little Karoo. Fruit capsules have 10-24 locules, with large closing bodies, broad valve wings and covering membranes with thick distal closing bulges.

Jordaaniella Hartmann: Coastal from southern Namibia to Riversdale in the southern Western Cape. A prostrate genus well adapted for living on sand, the main stem producing trailing stems which root at the nodes; in other respects it is, according to Hartmann, of low specialisation and therefore a primitive form within its group; although very distinct in its leaves and growth form, its capsule structure relates it to *Fenestraria*. Leaves are terete to obscurely angled, tapering at both ends, or obtuse-ended, apiculate, dull green. Winter-flowering, the flowers mostly yellow, orange, rarely white, solitary with bracteate pedicels. The capsule has 10-25 locules with small closing bodies. The genus was set up by Hartmann in 1984 (*Bot. Jahrb.* 104) for four species which were in *Cephalophyllum*: *J. clavifolia* (*Cephalophyllum clavifolium*) is located between Kleinsee and Hondeklip Bay in Namaqualand; its flowers are yellow, about 75 mm across, the leaves 18-50 mm long. *J. uniflora* (*Cephalophyllum uniflorum*) has much the same distribution; it has sharply 2-angled stems and yellow flowers about 70 mm across. *J. cuprea* (*Cephalophyllum cupreum*) occurs in the southern Namib and northern Namaqualand, its flowers are copper-coloured, yellow at base, 60-100 mm across. *J. dubia* (*Cephalophyllum dubium*) extends from Elands Bay in the south-west to the Gouritz River in the southern Cape; flowers mainly yellow, with a white form, 35-75 mm across, the leaves to 50 mm long.

Leipoldtia L.Bol.: From Aus in Namibia along a western belt in South Africa to the southern Western Cape and just entering the Eastern Cape; most species occur in Namaqualand. A monograph on *Leipoldtia* by Hartmann and Rust appeared in 1994 in which the genus was revised. At present eleven species and two subspecies are recognised; two of which are new species. These are woody shrubs, erect 170–600 mm, or prostrate with flowering stems shortly erect. The opposite leaves are slightly joined at the base, trigonous to subcylindrical, sometimes laterally compressed and navicular, bluish-green and may be densely dotted. The flowers which are usually pink (yellow in *L. frutescens*) appear in the winter and in two species the peduncles become spinescent. The filamentous stamens are centrally collected, the grey capsule has 10–12 locules, covering membranes undulate with closing rodlets at their outer ends, broad valve wings and large white closing bodies.

Hallianthus Hartmann: A wide distribution between 29° and 32° south and extending to nearly 20° east in Namaqualand and the Western Cape. Unassuming prostrate shrublets with slender stems to 120 mm long, growing in rock crevices. Leaves rounded-trigonous, becoming laterally compressed, 12 mm long with raised dots. Plants flower in the winter; the flowers 25 mm across with two colour forms – pink is predominant from northern Namaqualand to south of Vanrhynsdorp, and white in the Springbok-Steinkopf region only. In 1983 Hartmann set up this monotypic genus to accommodate *H. planus* (*Leipoldtia plana*); although its fruit supports its placement in the *Leipoldtinae*, its combination of characters excluded it from any of the existing genera in this group. The capsule is 10-locular, turret-like, the covering membranes with conspicuous elevations.

Pleiospilos N.E.Br. [colour p. 43]: Central and southern karoo areas. Dwarfed, squat, true mimicry plants, with smooth split-rock or irregular stone-like appearance. The opposite leaves are joined at the base, greyish-green or brownish, conspicuously dotted, the adaxial leaf surface flat, the lower surface often keeled and brought forward in a pronounced chin. The flowers are fragrant, opening at mid-afternoon, large, up to 80 mm in diameter, yellow to orange, appearing in winter (*P. nelli*) or autumn (April) in other species. The capsule is 9–15 locular with broad tapering valve wings and large white or brown closing bodies. In 1986 Hart-

mann and Liede (*Bot. Jahrb.* 106) divided the genus into *Tanquana* with three species (see Group 2.6) and *Pleiospilos*, which is subdivided into two subgenera:

1. **Pleiospilos** subgen. **Pleiospilos** (three species). Plants unbranched or only slightly branched, leaves short, the width often greater than the length, flowers 2–3. *P. bolusii* occurs in the upper reaches of the Sundays River valley (Graaff-Reinet and Aberdeen) in the Eastern Cape karoo. This species, with *P. nelli*, has the 'cleaved rock' habit. *P. nelli* is a neat succulent with hemi-spherical leaves, salmon-pink to yellow flowers, the capsule mostly 11-locular; located in the Great Karoo from Prince Albert to Willowmore, south of 33° south. *P. simulans* of the eastern Graaff-Reinet karoo is somewhat different, the opposite leaves widely spread, the keel less prominent and the fat lumpy leaf narrowing to a blunt apex.

2. **Pleiospilos** subgen. **Punctillaria** (N.E.Br.) Hartmann & Liede (one species, four subspecies). Plants branched, leaves twice as long as broad, or longer, mostly with subapical widening, flowers solitary, fruit tuberculate with large endocarp. Distribution in the Little and Great Karoo, from Ceres Karoo in the west to Steytlerville in the east. *P. compactus*: The typical subspecies occurs in the Little Karoo; it may form mats, the leaves 50–60 mm long, about 15 mm broad, the lower surface keeled towards the trigonous tip. Subsp. *canus* of the Great Karoo takes in a large synonymy of about 20 names, including *P. borealis* reported from the western Free State but not recently found there. Subsp. *fergusonae* is present in the Robertson Karoo, its leaves long-keeled, distinctly humped, flowers with pedicels 10 mm long, capsules mostly 10-locular. Subsp. *sororius* is a tufted plant of the Ceres Karoo, subsp. *minor* is a very small form of the Steytlerville Karoo. None of the subspecies of *P. compactus* exhibit the extreme mimicry forms found in the members of subgen. *Pleiospilos*.

Vanzijlia L.Bol. [colour p. 43]: Along the coastal region of Namaqualand from south of Hondeklip Bay to south of Lambert's Bay, in the southwestern Cape. In 1983 Hartmann (*Bot. Jahrb.* 103) recognised only one species, *V. annulata* (*V. angustipetala*) thus making *Vanzijlia* monotypic, and *V. rostellata* is transferred to *Cephalophyllum*, becoming *C. rostellum*. *Vanzijlia annulata* is a small shrub which has short shoots forming a compact centre from which several suberect to climbing stems develop. The leaf pairs are dimorphic: on the

short shoots the leaf pair (8-14 mm) is joined for nearly its whole length, forming a protective sheath in the dry season; on the long stems the leaf pair (20-40 mm) is joined for less than half its length; the leaves are glabrous and may be dotted. The flowers are solitary, terminal, with linear white to pinkish petals, the staminodes lengthen while the flower remains open. The capsule has 10 locules, the covering membranes have distal closing bulges and large closing bodies.

Schlechteranthus Schwantes: Richtersveld, in northern Namaqualand. Small shrubs, densely branched, up to 300 mm tall, somewhat similar in appearance to *Polymita*. The stubby, opposite leaves are conspicuously joined for up to half their length, smooth, glossy, trigonous, silvery-green, crowded on the branches. Flowers are solitary, sessile or shortly pedicellate, 7-11 mm across, petals purplish-pink to white, the capsule with 10-12 locules, the covering membranes marginally recurved, with distal spurs and closing bodies. Two species, *S. hallii* and *S. maximilianii* have been described. The genus has not been revised since its inception by Schwantes in 1929.

Cylindrophylloides Schwantes [colour p. 43]: Main distribution from Laingsburg into the Little Karoo, but apparently isolated near Loeriesfontein in the Northern Cape and Jansenville in the Eastern Cape. Mat-forming and cushion-like plants with cylindrical, finely dotted, greyish-green, crowded leaves 70-100 mm long and large solitary flowers, making it an excellent rockery plant in exposed conditions. The flowers are white, yellow or pinkish-red, about 70 mm across, with numerous stamens and staminodes. The capsule has 5-11 locules, the valve wings long, awned, sometimes absent, the keels toothed, covering membranes present with small closing bodies. The genus has not been revised since it was set up in 1927; there are at present five species. *C. calamiforme* is a mat-forming species found in the Laingsburg area; *C. comptonii* is yellow-flowered and occurs in the Little Karoo; very similar is the handsome *C. tugwelliae* which makes large tufted mats in the Prince Albert veld. The most colourful species is *C. dyeri* present near Jansenville in the Eastern Cape, in which the pale green leaves have reddened tips, it forms dense cushions with pink flowers. *C. hallii* was recorded as an outlier at Loeriesfontein but its distribution is unknown.



Aptenia cordifolia (p. 3)



Mesembryanthemum barklyi (p. 3)



Mesembryanthemum sp. (p. 3)



Phyllobolus canaliculatus (p. 4)



Sceletium tortuosum (p. 4)



Psilocaulon dinteri (p. 5)



Phyllobolus resurgens (p. 4)



Phyllobolus digitatus subsp. *digitatus*
(p. 4)



Caulipsolon rapaceum (p. 5)



Brownanthus pubescens (p. 5)



Skatophytum tripolium (p. 7)



Dorotheantus bellidiformis (p. 8)



Dorotheantus rourkei (p. 8)



Brownanthus glareicolus (p. 5)



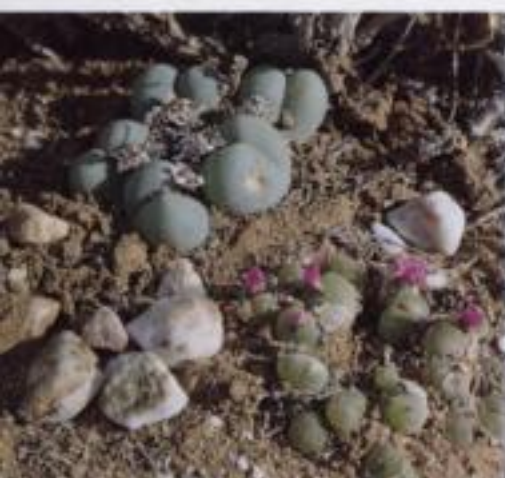
Oophytum oviforme and *Oophytum nanum*
(in flower) (p. 8)



Glottiphyllum linguiforme (p. 9)



Monilaria sp. from Riethuis (p. 10)



Gibbaeum heathii and flowering
Gibbaeum cryptopodium (p. 11)



Glottiphyllum regium (p. 9)



Jacobsenia kolbei (p. 10)



Monilaria scutata (p. 10)



Mitrophyllum grande (p. 10)



Gibbaeum petrense (p. 11)



Gibbaeum nebrownii (p. 11)



Gibbaeum pubescens
(p. 11)



Muiria hortenseae (left) with *Gibbaeum*
petrense (right) (p. 11)



Drosanthemum speciosum (p. 12)



Drosanthemum 'carpet', Karoo Botanic Garden, Worcester (p. 12)



Drosanthemum speciosum
(yellow form) (p. 12)



Drosanthemum striatum (p. 12)



Mestoklema tuberosum (p. 12)



Mestoklema arboriforme (p. 12)



Oscularia limata (p. 12)



Delosperma deilanthoides (p. 13)



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Trichodiadema intonsum (p. 14)



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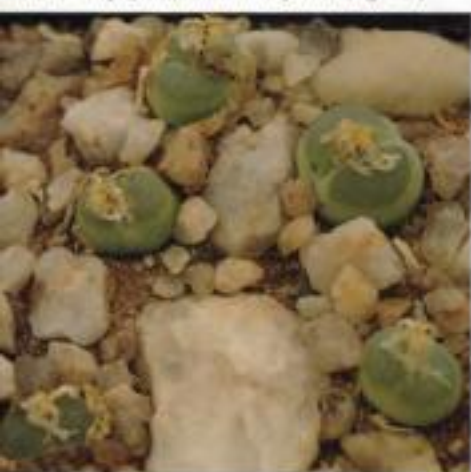
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Portulacaceae

Anacampseros and related genera

In 1861, Sonder wrote of the family Portulacaceae that 'none are of much use' (*Flora Capensis* 11). Be that as it may, the six genera which represent the family in southern Africa include many species of particular interest to the collector, and one alien, *Portulaca grandiflora* from Brazil, is a top-ranking cultivated annual grown in most summer gardens.

Two genera are dwarf to large woody shrubs, the berry-like fruit indehiscent and one-seeded: these are *Portulacaria* which has terminal clusters of bisexual flowers, and *Ceraria* which is dioecious (unisexual flowers on separate plants) with the inflorescences usually many-flowered and lateral. The remaining four taxa are herbaceous or small subshrubs with many-seeded capsules: the controversial *Anacampseros* and *Avonia* are dwarf perennial plants with 3-celled capsules which split longitudinally to dehisce winged or naked seeds. *Talinum* is a prostrate to erect genus, perennial with swollen rootstocks; the 3-celled capsule splits longitudinally and the seeds are not winged. In the genus *Portulaca* the species are annual or perennial, the one-celled capsule splits around the circumference, so that a small lid is shed.

Talinum Adanson

Although not succulent in the true collector's sense, plants of this genus possess fleshy rootstocks which allow annual shrubby growth. The attractive flowers in pink, white or yellow last only one day; the two sepals are keeled, stamens number 10-30, the capsule is shiny yellow and 3-valved, splitting longitudinally. Most species are of Mexican origin where their habit varies from mat-forming to shrubs nearly 1 m tall. In southern Africa there are five indigenous species: one of these, *T. portulacifolium*, has terminal pink flowers while the rest have axillary yellow flowers.

T. portulacifolium (Forssk.) Aschers. ex Schweinf. (*Talinum cuneifolium*): Mpumalanga and Northern Province in South Africa; Angola; widespread in Zimbabwe and further afield in Africa, Arabia and India. Semi-succulent with annual branches up to 1 m tall from the tuberous base; leaves obovate; flowers terminal and pink.

T. arnotii Hook. f.: Summer rainfall areas of South Africa; Namibia; Angola; Zimbabwe. Semi-erect, small shrubs with long, red-fleshed tubers; branches 300-400 mm long; leaves narrow to broadly elliptic, margins often turned under; axillary inflorescence 1-3 flowered.

T. caffrum (Thunb.) Eckl. & Zeyh. (*T. esculentum*): South Africa; Namibia; Angola; Lesotho; Swaziland; Zimbabwe; Zambia and northwards to Kenya. Prostrate or erect, the tubers with white flesh; leaves variable; inflorescence axillary and single-flowered, flowers yellow. According to Tölken, who revised the genus (*Bothalia* 10, 1969) *T. caffrum* can be distinguished by its spherical seeds which have concentric ridges, closely related species have kidney-shaped seeds.

T. tenuissimum Dinter: South Africa; Namibia; Mozambique; Zimbabwe; Zambia to Tanzania. Decumbent or semi-erect, tubers small and red-fleshed; leaves linear with revolute margins; inflorescence axillary with 1-2 yellow flowers, their pedicels thread-like. The 8-14 stamens distinguish it from the closely related *T. crispatum*; in the latter species, the stamens are always in excess of 20 and the leaves never have revolute margins.

T. crispatum Dinter: Cape; Transvaal; Namibia; Botswana; western Zimbabwe. Unlike the other four species, this species is dioecious. The stems are prostrate from branching tubers which have

white flesh; the leaf margins are crisped or undulate but never revolute. In the male plant, the ovary has no ovules; in the female plant, the yellow flowers have up to 30 staminodes without pollen, the ovary has 10-12 ovules.

Anacampseros L.

In 1992 M. Gerbaulet's investigation into *Anacampseros* was published (*Bot. Jahrb. Syst.* 113).

Closely related monotypic genera from America and Australia were included in the study. In a cladistic analysis 20 vegetative characters, 22 reproductive characters and one karyological character were used; this separated the American genera from *Tuberosae* (Australian, monotypic) and *Anacampseros* (Africa and Yemen) which, according to Gerbaulet, together form a monophyletic group. *Anacampseros* therefore has two subgenera: subgen. *Tuberosae* and subgen. *Anacampseros*, the latter divided into two sections, *Anacampseros* and *Avonia*.

In 1994 a reclassification of the five genera in question by Rowley was published in *Bradleya* 12. He lumps *Grahamia*, *Talinaria*, *Talinopsis*, the new genus *Xenia* and *Anacampseros* subgen. *Tuberosae* into the single genus, *Grahamia*. The main business of the reassessment is the elevation of the sectional *Anacampseros* and *Avonia* to generic status. Apart from a reinterpretation of information presented by Gerbaulet he accepts (with few exceptions) her findings and selection of valid species, and presents keys to both genera.

In 1995 Gerbaulet and Struck published a rebuttal (*Bot. Jahrb. Syst.* 117) in which the authors reject Rowley's re-classification and formally reinstate the earlier decision to maintain two sections. In their opinion the Rowley assessment appears to be highly artificial and the diagnosis of the tribe Anacampseroteae remains ambiguous; the lumping of all genera excepting *Anacampseros* under *Grahamia* creates a paraphyletic genus.

An interesting paper dealing with wide-band tracheids (cells supposed to have evolved as an adaptation to water stress) was presented by V. Landrum at the IOS Congress held in Cape Town in 1998. Stem WBTs were found only in *Anacampseros* and *Talinaria*, and in the leaves of *Anacampseros*, *Ceraria*, *Grahamia*, *Talinaria*, and *Talinopsis*. His deductions support the treatment of Gerbaulet.

It is not the function of this book to decide

which school of opinion is correct. The fact is that the elevation of the two different growth forms to generic level has been welcomed and species have since been described under the new epithet *Avonia*. To avoid confusion, the species hereunder are placed under two genera *Anacampseros* L. and *Avonia* (E.Mey. ex Fenzl) Rowl. and not under two sections.

Anacampseros L.

Dwarf shrublets 30-80 mm tall, rarely caudiciform and few-leaved, stems covered by fleshy close-packed leaves, glabrous, tomentose or cobwebby, with axillary bristles and hairs. Flowers sessile, solitary or several on raised flowering axis, seeds winged or naked.

Distribution of about 13 species in South Africa, five of which are present in Namibia, and one in Botswana. In the following account, distribution refers to the distribution maps by Gerbaulet (1992). In her account, Gerbaulet describes four types of habit: clustered with several stems as in *Anacampseros rufescens*, upright columnar as in *A. bae-seckii*, prostrate or 'bent down' as in *Avonia papyracea*, and rosette-forming as in *Anacampseros karasmontana*. She distinguishes seven different seed-types, using shape and the testa cells (the seed-types are not referred to in the following description of species).

Caudiciform miniature species

A. comptonii Pillans: From Nieuwoudtville to Clanwilliam in the south-western Cape. The short main stem (caudex) is almost fully buried, with 4-6 small, obovate leaves without papillae, 3-5 mm long. The bristles are white, 5 mm long. The inflorescence is without bracts, with a solitary flower, pale pink, with 5 stamens. **A. bayeriana** Hammer: Apparently present in three widely separate areas: the Richtersveld, south of Warmbad in Namibia, and south of Pella in Bushmanland. Also a small caudiciform, with 2-5 papillate leaves, bristles and hairs short. The inflorescence has no bracts and a solitary pale pink flower with 5 stamens; it seems barely distinguishable from *A. comptonii* in the south. **A. scopata** Williamson: Oograbies Mountains east of Port Nolloth in the south-west Richtersveld in the Northern Cape. According to its description (*Cact. & Succ. J. (US)* 66, 1994) this

miniature species which has numerous leaves is closest to *A. bayeriana*, which produces very few leaves, and *A. comptonii* which has 4-6 obovate leaves which are 3-5 mm long. The tuber measures 12 × 25 mm, giving rise to about 8 truncated stems, the leaves about 2 mm long, broadly elliptic to ovate, hidden by a mass of white hairs up to 5 mm long. The tiny flowers are white to pale pink, borne well above the leaves on pedicels 7-10 mm long, and provide a good match with those of *A. bayeriana* and *A. comptonii*. The flowers are self-pollinated and may be cleistogamous. In *A. scopata* flowering starts in the late summer, opening for only an hour at midday. The plants grow in narrow cracks at 400 m on vertical east-facing cliffs. Growing with this species is a densely hairy form of *A. baeseckii*, as well as a variety of sunken species which are well adapted to this extremely harsh environment.

Species in which the caudex is undeveloped or hidden, leaves glabrous

A. lanceolata (Haw.) Sweet (*A. affinis*, *A. angustifolia*, *A. trigona*): A long, narrow distribution from the Richtersveld to Worcester (subsp. *lanceolata*) and from Bredasdorp to Uniondale in the Western Cape (subsp. *nebrowii* (*A. nebrowii*)). Robust plants about 80 mm tall, the stem branching, leaves numerous, relatively loosely arranged, lanceolate, 25 mm long, tapering to spinous tips, upper surface flat, axillary hairs sparse, bristles shorter than the leaves in subsp. *lanceolata* and longer than the leaves in subsp. *nebrowii*. The flowering axis with 5 or more leaf-like bracts which also have brown hairs, 1-4 white or pink flowers, the open flower about 30 mm across, with 30-45 stamens, testa cells elongated and the seeds 3-angled.

A. rufescens (Haw.) Sweet (*A. marlothii*): An eastern distribution in Free State, Lesotho, KwaZulu-Natal and Eastern Cape. Rowley (1994) upholds *A. marlothii* on the grounds that cultivated specimens are easily distinguished by 'soft, almost linear, green incurving leaves'; this would have to be substantiated by field observation. A mat-forming species, about 80 mm tall, leaves densely spiralled round the short stems, leaves about 20 mm long, 10 mm wide, acute, lower surface reddish, axillary hairs numerous, inflorescence up to 100 mm high with 2-4 pink flowers with 30-45 stamens, the testa cells isodiametric.

A. telephiastrum DC. [colour p. 44] (*A. varians*): A robust species widespread in the southern karoo from Robertson in the Western Cape to Somerset East in the Eastern Cape. The older plants become tufted, leaves relatively loosely disposed, brownish-green with papillae, not reddish below, about 18 mm long, axillary hairs few, hairs and bristles shorter than the leaves. Inflorescence to 150 mm, bearing 1-4 pink flowers 30-35 mm across, with 30-45 stamens; testa cells oblong.

A. retusa Poelln. (*A. truncata*, *A. nitida*): A long distribution (which, like many species in southern Africa, seems to follow the main roadway) from Lüderitz in Namibia through Namaqualand to Ceres Karoo and Worcester. A short thickened caudex which has branch stems about 40 mm long with obovate, dark green, crowded leaves which have hook cells, rarely papillate, tomentum present but not always distinct. Inflorescence many-flowered, petals pale to dark pink, stamens about 25.

A. pisina Williamson: Exposed on south-west slopes of Umdaus ridges north of Steinkopf in the Richtersveld. The aerial stem is about 25 mm tall, arising from a tuber which is up to 20 mm long. Leaves 11 mm long, 8 mm broad, light green, with clusters of chloroplasts, channelled to a subacute apex, glabrous, axillary hairs densely tufted, fine to bristle-like, reddish brown to yellow. Inflorescence of 25 mm, bracteate, with 1-3 flowers, petals shiny white, stamens 25.

Species with tomentose leaves (matted, cottony pubescence)

A. arachnoides (Haw.) Sims (*A. depauperata*, *A. gracilis*, *A. rubroviridis*, *A. schoenlandii*, *A. rubens*): From the Little and Great Karoo into the Eastern Cape. Erect stems about 50 mm high, leaves ovate, acute or mucronate, about 20 mm long, 15 mm wide, surface sparsely cottony. Flowers purplish, about 30 mm across, stamens 25, stigma 3-branched.

A. subnuda Poelln. (*A. starkiana*): An upright species, subsp. *subnuda* occurs widely in the Transvaal as far west as south-east Botswana, it has bristles and hairs longer than the leaves. Subsp. *lubbersii* (*A. lubbersii*) occurs near Middelburg in Mpumalanga and its bristles and hairs are shorter than the leaves. The species also occurs in western and

southern Zimbabwe (*Excelsa* 15, 1991). The stems are up to 50 mm high, densely-leaved, the young leaves felted, older leaves becoming glabrous, hooked cells present or absent. The inflorescence bracteate with pink flowers, stamens 25.

A. karasmontana Dinter (*A. dielsiana*): Southern Namibia and just south of the Orange River at Kamas. Roots slender, stems not usually branched, about 20 mm high with white-felted wedge-shaped leaves forming a rosette. Bristles as long as the leaves or longer, with numerous hairs. The inflorescence bracteate with 1-3 flowers, the petals pale pink, the number of stamens 25, stigma 3-branched.

A. albidiflora Poelln.: Widespread in Great and Little Karoo. Erect, columnar stems densely covered with small, reddish-green felted leaves about 7 mm long and 5 mm wide, the leaf almost round, with down curving tips and distinct hook cells, bristles numerous, longer than the leaves, white and curling up to 20 mm. The inflorescence bracteate, flowers white or pale pink, stamens 25.

A. baeseckeii Dinter [colour p. 44]: Southern Namibia, northern Namaqualand and Bushmanland. Erect to about 30 mm, densely-leaved, leaves about 4 mm long, 3 mm broad, tomentose, the hook cells merged into solid plates and hairs densely matted, brownish bristles curled and sparse, longer than the leaves. Inflorescence bracteate, flowers dark pink or red, paler at the edges, with 25 stamens.

A. filamentosa (Haw.) Sims (*A. lanigera*): A tremendous inland distribution from northern Namibia, along and north of the Orange River, into the Free State and central karoo. Subsp. *filamentosa* which has the South African distribution is much-branched and densely-leaved, the small leaves ovate to round, often with truncated tips, and covered with white threads, bristles numerous. The inflorescence is about 80 mm high with up to 5 flowers, 30 mm across, petals pink. Subsp. *tomentosa* (*A. tomentosa*, *A. densifolia*, *A. paradoxa*) applies to the Namibian plants. (It is noted here that, apart from a difference in seed-type, the descriptions of *A. albidiflora* and *A. filamentosa* in Gerbaulet's revision (1992) are identical, making identification from this source almost impossible.) **A. namaquensis** Pearson & Stephens (*A. alta*, *A. poellnitziana*) from the Richtersveld southwards to the Tanqua Karoo is recognised by Gerbaulet on the only distinction of having bristles shorter than the

leaves, whereas in subsp. *filamentosa* they are longer than the leaves. Rowley in his key to the species reduces the rank of *A. namaquensis* to subsp. *namaquensis* under *A. filamentosa*. It is also noted here that the sepals of *A. namaquensis* are recorded as being 6 mm long and with green stripes and longer than the petals, this character was used by Von Poellnitz (1933) in his key to distinguish the species. Considering its great range and its extensive synonymy, the *A. filamentosa*-complex should be fully investigated in the field; if there are substantial differences (particularly regarding the Namibian component) they have not yet been confidently stated and subspecies are not included in the Gerbaulet (1992) key to the species.

Avonia (E.Mey. ex Fenzl) Rowl.

Dwarf plants in which the stems, semi-erect or prostrate, are covered by white overlapping papery stipules, (in Marloth's words, 'like the scales of a fish'), this cover reducing transpiration and trapping dew. The minute leaves are hidden behind the stipular scales. Similar to *Anacampseros* in flower and fruit but without an extended peduncle, the flowers are solitary at the tips of the stems. Many mimic their surroundings, for example *Avonia papyracea* is pure white and grows in white quartz patches. The ephemeral flowers are showy in white, pink and red, opening for a few hours in bright sunlight.

A. quinaria (E.Mey. ex Fenzl) Rowl. [colour p. 44]: Warmbad in Namibia, Bushmanland and eastwards to Keimos on the Orange River; in Namaqualand as far south as Bitterfontein. The species often resembles a coral growth, having a compact underground organ from which very short stems appear, forming a small cushion, the flowering stems longer and thicker than the rest. Minute hemispherical leaves are hidden by the ovate to triangular stipular scales which have toothed margins. Gerbaulet places *Anacampseros alstonii* in synonymy under this species. Rowley, without defining its distribution, sets up *Avonia quinaria* subsp. *alstonii*, which has larger white to pink flowers 25-30 mm across, compared to those of the typical plants which have purple flowers 15 mm across. The flowers are erect, spectacular, the buds bent low, stamens 40-80.

A. rhodesica (N.E.Br.) Rowl. [colour p. 44] (*Anacampseros bremekampii*, *A. decipiens*, *A. fissa*):



Avonia quinaria subsp. *alstonii*

Widespread (except in the north) on granite outcrops in Zimbabwe, in the North East District of Botswana, and in the Northern Province (Transvaal). A small caudex gives rise to a tuft of short, pointed stems up to 30 mm tall, usually growing in fissures of rock. The minute, sessile, fleshy leaves 1×1.5 mm, lie behind the overlapping silvery scales which are ovate-orbicular, with a terminal cusp which splits. Flowers are white, apricot or pale pink, fragrant, solitary, terminal, almost hidden by the bracts; petals 2.5–6 mm long, stamens 6–8, the capsule 3 mm long. This species shares with *A. dinteri* the most northerly distribution of the genus.

A. dinteri (Schinz) Rowl. [colour p. 44] (*Anacampseros ombonensis*, *A. wischkonii*): North and north-west of Karibib in Namibia. Plants many-stemmed, stems up to 100 mm long, prostrate, covered with broadly ovate, acute-tipped, brownish scales which have a raised darker median line, the leaf axils without hairs. The flowers are pink or red, with about 10 stamens.

A. albissima (Marloth) Rowl. [colour p. 44] (*Anacampseros avasmontana*, *A. neglecta*, *A. schmidtii*): Namibia, northern Namaqualand, Bushmanland and Griqualand West. Many slender stems about 40

mm long, 3–4 mm in diameter, closely covered with stubby, grey, brown-flecked stipular scales with entire or lacinate margins, leaf axils hairy. The flowers are white, fragrant, with 10 stamens.

A. herreana (Poelln.) Rowl.: Richtersveld. Short prostrate stems about 10 mm long which branch dichotomously; small round leaves are spirally arranged and hidden by acute, adpressed stipular scales which have a brown median nerve, axillary hairs are present, shorter or as long as the scales. Flowers are white, fragrant and have about 10 stamens.

A. recurvata (Schönl.) Rowl. (*Anacampseros meyeri*): The typical plants occur from Steinkopf in Namaqualand to Pofadder, subsp. *buderiana* in Hells-kloof, Richtersveld, and subsp. *minuta* at Maraisvlei in Bushmanland, all taxa lying south of the Orange River in the Northern Cape. Branch stems up to 80 mm long arise from a tuberous rootstock, erect or semi-erect with spirally arranged leaves covered by lanceolate stipular scales about 3 mm long, laxly arranged, partly exposing the leaf-tips, with a yellowish-green median line, scale tips when curving outwards giving the stem a shaggy appearance; axillary hairs are present. In the typical plants the scale tips are turned outwards; in subsp. *buderiana* the scale tips are turned inwards and the middle line is inconspicuous or missing. In subsp. *minuta* the scale apex turns outwards and the scale has a broad yellow middle line. Flowers are scented with about 15 stamens.

A. ruschii (Dinter & Poelln.) Rowl.: Bushmanland and the Warmbad district in southern Namibia. The habit is somewhat like that of *A. papyracea*, the branches are mostly simple, about 40 mm long and 7 mm broad. The stipular scales (3–5 mm long) are hooked and curve outward at the tips, broad-ovate or ligulate, whitish, sometimes with a brown median stripe and brown flecks, with numerous axillary hairs which are longer than the scales and give the stem a shaggy appearance. Flowers are fragrant with white petals and about 10 stamens.

A. ustulata (E.Mey. ex Fenzl) Rowl.: Free State, Botswana, central and eastern Great Karoo. Branch stems that develop from the caudex are numerous and narrow, about 30 mm long, covered with short side shoots; the kidney shaped leaves concealed by minute, closely adpressed, apiculate, ovate scales with lacerate margins and a dark freckle near the

top of the scale, hairs very few. Flowers are scented, white, equal to the involucre of bracts and conspicuous, with 10 stamens. *A. ustulata* was known as the 'moerplantjie' as it was used by farmers for preparing yeast used in making yeast buns, and was also used in the brewing of beer. Probably close to this is the new species, *A. mallei* Williamson, collected at Maerpoort in Namaqualand. These are dwarf plants, 40-80 mm tall, with tuberous roots, the stems branching and with many stubby branchlets along the stem length. The apical part of the scale is black-veined with a lacerated black apical margin which has some recurved projections, a tuft of short white hairs at base of scale. White bracts surround the solitary terminal flower which has a ring of nectar glands, 8 stamens, and shiny lime-green petals; the plants flower in February. *A. prominens* Williamson is another newly described species from near Soetwater in the southern Richtersveld on south-west steep quartz slopes. Plants are 80-100 mm tall, with many spreading-erect branches covered with tight grey stipular scales, black-specked, upper scales elongated-ovate, margins mainly entire. The leaves are succulent, hidden, papillate, mature leaves have an inward-curved rounded apex and fine white hairs at the base. The bracts completely cover the flowers which are terminal, the petals a light translucent green, 10-12 stamens. The plants are large in comparison with others of the genus.

A. papyracea (E.Mey. ex Fenzl) Rowl. [colour p. 44]: The typical plants are present in the Little Karoo and Great Karoo. Subsp. *namaensis* occurs in the Richtersveld, southern Namibia and Bushmanland. Probably the best known member of its genus, the white, scale-covered stems grow flat on the ground, often curved, arising from a thickened root. The stems are about 50 mm long, 8-10 mm thick, with blunt ends. The leaves are hidden by ligulate to broad-ovate stipular scales which clasp the stem firmly at base and apically, axillary hairs are present. The flowers are white, scented, with about 20 stamens. Gerbaulet places *Anacampseros variabilis* into synonymy with subsp. *namaensis* on the grounds of a seed difference with no other morphological dissimilarities. Williamson in *Aloe* 35(1), 1998 reinstates *Anacampseros variabilis* and gives it the new combination *Avonia variabilis* (Poelln.) Williamson: this species occurs only in the lower Gariep valley on both sides of the Orange River; the nearest specimens of *A. papyracea* subsp. *namaensis* lie separately at least 15 km dis-

tant. *A. variabilis* has a very large tuber, with erect to suberect short pointed stems, not blunt-ended, and the flowers are yellow to pale yellow.

Portulacaria L.

A shrubby genus of three species occurring in South Africa, Namibia and Mozambique. The stems are well-covered with fleshy, *crassula*-type leaves which are sessile and obovate; flowers small and pink or white, the ovary one-chambered with a single basal ovule.

P. afra Jacq. [colour p. 44]: A common, robust shrub 2-5 m tall occurring from east of Ladismith in the Little Karoo to the Eastern Cape, through Kwazulu-Natal, Swaziland and the Transvaal into Mozambique. It is not certain whether it occurs naturally in Mozambique; Wild in *Flora Zambesiaca* 1(2), 1961 writes that it is cultivated for cattle fodder in Zimbabwe and Mozambique. It develops thick, supple stems with opposite branchlets (not all of which lengthen) densely foliate with small, fresh-green, sessile, fleshy leaves. Better known as *spekboom*, ('fat tree', the word 'spek' actually means 'bacon'; or 'Elephants food') this shrub is a valuable stock food particularly during drought. It was introduced into Europe during the 18th century and is recorded as having flowered in Vienna in the year of the French Revolution. It seldom produces its tiny pink flowers in cultivation but if kept very dry the older plants may flower after rain. According to C.A. Smith (1966) there are two strains of the plant, the sour *spekboom* and the sweet *spekboom*, the latter practically eaten out of existence by all stock and wild antelope. The species is host to a mistletoe called *Viscum crassulae*, which looks much like the host it lives on.

P. armiana Van Jaarsveld [colour p. 44]: The large-leaved *spekboom* was discovered in 1982 by Anthony Mitchell who, incredibly, travelled by bicycle into the hot desolate region north of the Orange River in southern Namibia. Van Jaarsveld records that the plants were found on the Kuamsib, a spur of the Hunsberge which run from north to south. The plant is a branched woody shrub, 400-700 mm in height and up to 1 m in diameter. The bark splits and peels; the leaves are green, obovate, up to 70 mm long and 50 mm wide. The unusual character is the tall, rod-like inflorescence which reaches 3 m (or more) in height, bracteate

near the apex, and does not die back but is perennial, obviously accounting for its great height. The peduncle is sparsely branched, bearing small, white flowers about 3 mm long. *Zygophyllum prismatocarpum* which occurs in the same habitat on the northern and western hill slopes, has a superficial resemblance to *P. armiana*. The dwarf *P. pygmaea* which occurs in the Richtersveld is the nearest relative of *P. armiana*, but both species exist a great distance away from *P. afra*.

P. pygmaea Pillans [colour p. 44] (*Ceraria pygmaea*): Richtersveld in Namaqualand and southern Namibia. Dwarf plants with thick tuberous water-



The minute flowers of *Portulacaria pygmaea*

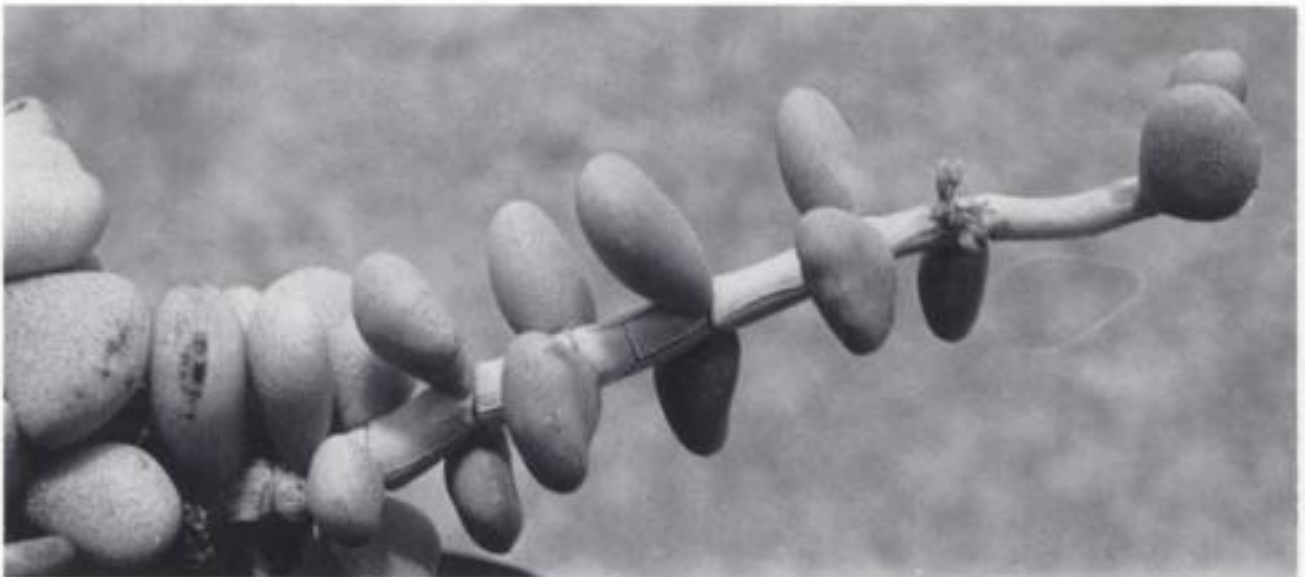
storing rootstocks, found in the hot arid regions of the northern Richtersveld and across the Orange River to south of Lüderitz. The plants are compact, up to 200 mm tall and 300 mm in diameter, forming mounds on hilly slopes. The thick, sessile leaves (10-14 mm long, 7-9 mm across) are bluish-green; the small, inconspicuous flowers are pale pink, usually in terminal clusters of 2-6.

Ceraria Pearson & Stephens

Small to large branching shrubs native to Namaqualand, Bushmanland and Namibia. The branches are often nude with greatly reduced leaves; the inflorescence produces 2-6 small, pink flowers. The plants are dioecious (male and female flowers on separate plants).

C. fruticulosa Pearson & Stephens (*C. schaeferi*): Bushmanland, Namibia south of Luderitz, Warmbad and Keetmanshoop. Much-branched, twiggy species from 300 mm to 2 m tall. Slender, glabrous stems, whitish when young, sessile leaves much reduced, 4-6 mm long, leaf cushions in 4 ranks; inflorescence of 1-6 shortly pedicellate flowers.

C. longipedunculata Merxm. & Podlech: Kaokoveld and Outjo in Namibia. Freely branching shrub with reddish-brown stems; fleshy leaves 6-15 mm long; peduncle 10-40 mm long, pink flowers 5 mm in diameter.



Portulacaria pygmaea from the Richtersveld

C. namaquensis (Sond.) Pearson & Stephens (*Portulacaria namaquensis*, *Ceraria gariepina*): Namaqualand; Namibia: south of Lüderitz and Warmbad district. Shrubs or small trees with very thick forked branches, 1.5-3 m tall. The dry bark is strongly wrinkled, mostly grey, often pruinose. The leaves (3-4 mm long) are fleshy, obovate and deciduous.

Portulaca L.

Portulaca is a large, cosmopolitan genus of small, succulent, annual or perennial plants best represented in South America but also occurring in tropical Africa, islands of the Pacific, China and the Far East. Many of the species are inconspicuous or, like *P. oleracea*, are fleshy weeds, and few are of real interest to the succulent collector. The genus is easily distinguished from the rest of Portulacaceae by its one-celled capsule which splits in circular fashion to expose a cupule filled with numerous seeds. It will be noticed that the following species have, generally, a Namibia-Botswana-Zimbabwe-Mozambique distribution. Patricia Craven (NBRI, Windhoek) writes 'all the *Portulaca* are fairly weedy, but some are common on quartz outcrops and will be noticed by *Lithops* hunters' (pers. comm.).

P. collina: Namibia, Botswana, Zimbabwe. Perennial dwarf species with a long, thickened root and several segmented stems up to 100 mm tall; leaves lanceolate, acute with revolute margins, up to 9 mm long, with numerous, spreading bristle-hairs. Flower 8 mm across, yellow.

P. foliosa Ker. Gaul.: From Namibia and Angola in

the west to Mozambique in the east. Robust species erect to 300 mm tall or semi-prostrate with pinkish-red stems; leaves terete, 20 mm. long; bristle-hairs conspicuous on stem and particularly under the terminal inflorescence; flowers yellow, stamens 8-13.

P. hereroensis Schinz: Namibia, Botswana, Zimbabwe, Mozambique. A common extremely small annual species with reddish stems often found creeping on sandy soil, the stems branching in forked manner; bristle-hairs present. Flowers solitary or 2-3, pale yellow, purplish or white, stamens 4. Often a pioneer on bare alluvial soils.

P. kermesina N.E.Br.: Namibia, Botswana, Transvaal, Zimbabwe. Allied to *P. foliosa*; stems spreading or erect to 400 mm, the linear leaves usually terminal, the segmented stem largely leafless and densely hairy; the bristle-hairs 4-8 mm long. Flowers red, stamens 5.

A. quadrifida L.: Namibia; Zimbabwe and further wide distribution. A small 'cottony' prostrate species; the obovate to linear leaves fleshy, red and mainly at the tips of the branches, the rest of the stem well covered by the bristle-hairs; flowers small, yellow-orange, stamens 8-12.

P. rhodesiana Dyer & Bruce: Zimbabwe, Mozambique. An annual herb with a small, tuberous root, 50-70 mm high, forming much-branched, dense mats in rock crevices or in shallow rain pools on granite. The red stems are entirely glabrous, the leaves opposite, succulent, bladder-like, pinkish and almost globular; flowers small, terminal, bright pink, stamens 4.

Crassulaceae

Crassula and related genera

The family Crassulaceae is composed of a large number of annual and perennial species with simple, more or less succulent leaves. They are distributed throughout the world and show ready adaptability to a wide range of climatic conditions. In South Africa, many species keep to the shady aspects of southern slopes, overhanging rocks or larger plants, but some have become highly specialised for survival in exposed desert-like conditions.

The genus *Cotyledon* was first described by Linnaeus, after which various elements were separated from it in the creation of other genera such as *Adromischus*, in 1852. In 1828 De Candolle recognised three elements in *Cotyledon*: those with opposite leaves, those with alternate leaves which wither and drop away, and those with alternate persistent leaves. This simple concept, together with certain epidermal and floral features, is embodied in Tölken's separation of the genera, one of them being his new genus, *Tylecodon* (Crassulaceae 14 (FSA) 1985). The largest genus is *Crassula*, which, with *Cotyledon*, was described by Linnaeus in 1753. *Kalanchoe* differs from the rest in having its centre in tropical Africa and Madagascar, extending to south-eastern Asia and northern Australia; only 13 species are recorded from southern Africa.

Crassulaceae was revised by H.R. Tölken (*Flora of Southern Africa* 14, 1985), a Herculean task, and his findings are referred to here, especially in descriptions of *Cotyledon*, *Kalanchoe* and *Crassula*; since 1985 more work has been carried out on *Tylecodon* and *Adromischus*.

Cotyledon L.: Leaves opposite, stiff and persistent; peduncle distinct with abrupt change from leaves to bracts; corolla of 5 petals fused into a tube often longer than the corolla lobes, nectary joined to the carpel forming a cup, the stamens 10 in two whorls.

Tylecodon Tölken: Leaves spirally arranged, succulent, deciduous; gradual change from leaves to

bracts on the peduncle; corolla of 5 petals fused into a tube usually longer than the corolla lobes, nectary scales disc-like, free, stamens 10 in two whorls.

Adromischus Lem.: Leaves spirally arranged, stiff and persistent; abrupt change from leaves to bracts on peduncle; corolla of 5 petals fused into a tube with short spreading lobes joined at their base, nectary scales disc-like, free, stamens 10 in two whorls.

Kalanchoe Adans.: Leaves opposite, succulent, persistent or deciduous, corolla with 4 petals fused into a tube longer than the lobes, stamens 8 in two whorls.

Crassula L.: Leaves opposite, more or less joined at base, succulent, persistent or deciduous, flowers usually 5-merous, corolla with mostly 5 petals, spreading, free for most of their length, 5 stamens in one whorl.

Cotyledon L.

Common name: 'Plakkie'. The separation of *Tylecodon* from *Cotyledon* has greatly reduced the limits of this much-dissected old Linnean genus. Its modern concept is that of a branching, succulent shrub; the leaves opposite, smooth and waxy; the peduncle nude with a few bracts and non-leafy; the tubular flowers bell-like, pendulous in red, yellow and orange and pollinated by sunbirds; the 10 stamens fused to the tube for about one-third of their length from the base; the gynaecium consisting of 5 free carpels each with a slender style and nectaries cup-like. Distribution of the nine species is almost entirely South African. They are not really popular with gardeners, but if used correctly in landscaping with rocks the grey to green red-margined leaves make an excellent contrast, the flowers are held high and bold; the trick is to remove old inflorescences (excellent for dry-flower arranging) before

they straggle, and shrubs need pruning to keep them neat.

C. campanulata Marloth [colour p. 93] (*C. teretifolia*): Fairly common in the Eastern Cape from Willowmore to Graaff-Reinet and southwards, forming spreading clumps up to 200 mm in karoid scrub. The opposite leaves are linear to lanceolate, 50-80 mm long, densely glandular-hairy and yellowish-green. The peduncle is up to 350 mm, the flowers yellow, corolla tube 5-8 mm, the lobes reflexed and straight; flowering from October to December.

C. velutina Hook.f. (*C. beckeri*, *C. mollis* Schönl.): Common in the Eastern Cape from Joubertina in the Langkloof to East London. Shrubs up to 2 m; leaves opposite, oblanceolate, 50-90 mm long and about 30 mm broad, flattened, glabrous to hairy, greenish-brown. The peduncle is up to 600 mm, the flowers orange with yellow margins, the corolla tube up to 17 mm long, lobes recoiled, flowering from November. The plants are coastal, extending well inland. Near East London and further east the plants become densely hairy.

C. adscendens R.A.Dyer: Restricted to a small area on the sand dunes east of Port Elizabeth at Swartkops in the Eastern Cape; shrubby or scrambling up to 2 m in height, with few branches. Leaves opposite, obovate, 20-45 mm long, somewhat flattened, usually acute, glabrous with waxy surface flaking, yellowish-green with red margin. The peduncle is 250 mm, glabrous, flowers orange-red, tube up to 15 mm, flowering October to December.

C. woodii Schönl. & Bak.f. [colour p. 93] (*C. salmiana* var. *woodii*, *C. ramosissima* var. *woodii*): From Ladismith in the Little Karoo to Graaff-Reinet in the Eastern Cape, but selecting shaded kloofs. Well branched shrubs up to 1.2 m. Opposite leaves oblanceolate to obovate, to 27 mm long, dorsiventrally compressed, glabrous with flaking wax, dark green with reddish margin. The peduncle is glabrous, the flowers few, greenish-red to orange, the corolla tube 12-15 mm long, lobes recurved. It is distinguished from the scrambler *C. adscendens* by its woody stems; it flowers in response to rain but mainly December to April.

C. barbeyi Schweinf. ex Bak. (*C. wickensii*, *C. transvaalensis*, *C. sturmiana*): An unusual eastern distri-

bution which lies north of 28° south, in northern KwaZulu-Natal, Swaziland, the Northern Province and Mpumalanga (Transvaal), widespread in Zimbabwe, and northwards to Ethiopia and the Arabian Peninsula, so this must be a very old species. An erect shrub to 2 m, much branched, the opposite leaves oblanceolate to linear, abruptly acute at the apex, flattened, glabrous to glandular-hairy, green to brown. The peduncle is about 350 mm, with the same indumentum, the flowers orange to deep red, corolla tube about 16 mm, bulging at base, glabrous to densely hairy, lobes long and recoiled. Flowering is from June to August in southern Africa.

The species described so far all have an eastern distribution, those that follow extend from west to east.

C. tomentosa Harv. [colour p. 93]: From Ladismith in the Little Karoo to Steytlerville in the Eastern Cape. Branched shrublets less than 500 mm tall. Differences in leaf character account for the separation into two subspecies: subsp. *tomentosa* is a much-branched, bushy plant with green, villose oblanceolate, somewhat dorsiventrally compressed leaves which are 15-25 mm long with 3-5 apical teeth. It occurs in the southern karoo areas of Calitzdorp, Willowmore and Steytlerville. Subsp. *ladismithiensis* (*C. ladismithiensis*, *C. heterophylla*) is little-branched with larger, almost terete leaves which are tomentose, 30-50 mm long with 1(-3) apical teeth; present on rocky outcrops between Laingsburg and Ladismith and southwards to Miskraal in the southern Western Cape. The peduncle is 150-250 mm, flowers orange to yellow, corolla tube 12-16 mm long, slightly dilated at the base, hairy outside; flowering from July to September.

C. cuneata Thunb. [colour p. 93] (*C. pillansii*): On the hills surrounding Springbok in Namaqualand, southwards to Calvinia, from Piquetberg across the Great Karoo to Graaff-Reinet and south to Willowmore in the Eastern Cape. Low growing shrublet with spreading branches, leaves broadly obovate, cuspidate, flattened, glabrous, yellowish-green. The peduncle is up to 350 mm, viscid, the flowers yellow, corolla tube 6-10 mm, viscid on the outside, corolla lobes reflexed and straight. Flowering is from November to December.

C. orbiculata L. [colour p. 93]: Probably the best known and least understood of the *Cotyledon* spe-

cies. It has the largest synonymy (about 43 names), and four varieties. It has the most extensive distribution, from south-western Angola and Namibia to the Cape Peninsula, across the southern karoo and Free State into the eastern regions of South Africa, keeping to the mountain ranges. Var. *orbiculata* (18 synonyms): from Angola to the south-western Cape, on most mountain ranges but not the southern Drakensberg, keeping to a western-central and southern position in South Africa. Shrubby up to 300 mm or more when not in flower; the leaves oblanceolate, obovate to orbicular, green or greyish-green to grey-brown with red horny margins. The peduncles to 350 mm, the flowers deep red, also pale orange or pink due to the bloom on the corolla; tube 10-14 mm long. Var. *spuria* (L.) Tölken (*C. spuria*, *C. purpurea*): from Calvinia to the Langebaan coastline in the south-western Cape, and eastwards to the Little Karoo. Up to 1 m excluding the inflorescence. Leaves oblanceolate, greyish-green with a thick bloom and red margin. Inflorescence up to 800 mm, the peduncle with 3-5 pairs of bracts. Flowers orange to pale yellow (the yellow form often seen between Robertson and Worcester), corolla tube 20-25 mm long. Var. *oblonga* (Haw.) DC. (21 synonyms): almost entirely eastern, from the Eastern Cape and KwaZulu-Natal, Free State and Swaziland into Mpumalanga and the Northern Province (Transvaal). The plants have decumbent branches to a height of 800 mm excluding the inflorescence. Leaves obovate to oblanceolate, 50-110 mm long, closely packed on the stem, green to glaucous, red apical margin, glabrous to hairy (KwaZulu-Natal), narrow and terete leaves present in southern Drakensberg. Inflorescence 200-350 mm, corolla orange to red, tube 20-25 mm long, flowering July to September. Var. *dactyloopsis* Tölken: on dolerite outcrops in hilly country from Kimberley to De Aar in the Northern Cape and across the central Free State. Shrublets up to 250 mm, the inflorescence adding 300 mm to its height. Leaves glabrous, linear-lanceolate, 50-80 mm long, tapering to a point, green, rarely glaucous, densely clustered. Flowers yellow, corolla tube 8-10 mm, flowering October to December. This variety is similar vegetatively to var. *oblonga* with terete leaves in the north-eastern Eastern Cape. Var. *flanagani* (Schönl. & Bak.f.) Tölken (*C. flanagani*): only present on the hills surrounding the lower Kei River north of East London in the Eastern Cape. A spreading shrub up to 1 m tall, linear leaves in whorls of three, 70-90 mm long, terete and sharp-pointed, green to grey. The peduncle 250-400 mm,

flowers red, with bloom, tube 12-15 mm long, the free lobes 10-14 mm, acute and recoiled. In summary, the typical var. *orbiculata* occurs widely in the west but is absent in the Free State, KwaZulu-Natal and Transvaal Provinces, var. *spuria* is south-western Cape and Little Karoo, var. *dactyloopsis* is central in Northern Cape and Free State, var. *oblonga* is entirely eastern, and var. *flanagani* is localised in the Eastern Cape. Becoming familiar with the taxonomy of this species is not for the faint-hearted; the puzzler is that plants with terete leaves grow with plants that have dorsiventrally flattened leaves, both belonging to var. *orbiculata*, plants with undulate margins (Laingsburg) are said to merge with the smooth-margined var. *orbiculata*. This robust species is a most variable complex.

C. papillaris L.f. [colour p. 93]: Widely distributed from south-western Namibia to the Tanqua Karoo and Little Karoo in the Western Cape, extending into the Eastern Cape. This small, very variable species has an extensive synonymy which is not given here. A shrublet with slender decumbent branches up to 150 mm long, the stems 3-5 mm in diameter, leaves linear-lanceolate to oblanceolate, 20-40 mm long, acute, green or yellowish-green with red margin. The peduncle is 100-250 mm, flowers orange to deep red, the corolla tube 5-8 mm long, lobes strongly recurved, flowering from October to December. Tölken distinguishes three local forms which deviate from the typical and are often recognised: plants in which the leaves are spindle-shaped and the upper parts of the inflorescence are glandular-pubescent, these are found throughout the range; plants in which the leaves are somewhat flattened and the inflorescence has few glandular hairs, sometimes found in the Eastern Cape; and plants which have very slender stems, with flat, yellow-green leaves under 20 mm in length, rarely occurring in the Eastern Cape.

Tylecodon Tölken

The name *Tylecodon* (an anagram of *Cotyledon*) was coined by Tölken who described his new genus in *Bothalia* 12 (1978). *Tylecodon* species are distinguished from those of *Cotyledon* by their spirally arranged, soft, non-waxy leaves which are deciduous, often leaving behind large persistent leaf bases called phyllopodia. The flowers are usually erect or spreading, the calyx often having club-shaped hairs.

Unlike both *Cotyledon* and *Adromischus*, the new genus shows a gradual transition from leaves to bracts on the flowering axis. The petals are fused for less than the full length of the tube, the nectary scales are disc-like and free. The species vary in habit from large shrubs to very small plants a few centimetres high. Type species: *T. cacalioides* (L.f.) Tölken.

The species are endemic to Namibia and South Africa, concentrated in the dry western regions which have winter rainfall. In this account 45 species are divided into two groups, dwarf to small shrubby species, and medium to large shrubs. They are also grouped in the following geographic divisions: Namibia, Richtersveld (northern Namaqualand), Namaqualand south of the Richtersveld and the southern karoo region, but it should be noted that many species have extended distributions.

- 1 Dwarf to small species with several to many stems arising from a buried or partly exposed caudex

1.1 Namibia

T. singularis (R.A.Dyer) Tölken (*Cotyledon singularis*): Namibia: on the foothills of the Hunsberge near Rosh Pinah, where sea-mist condenses on the soil and plant leaves. According to Dyer, who described it, this species is only recognisable as belonging to Crassulaceae when in flower. It is, as its name implies, most unusual: stemless, with tuberous roots, producing one or two spreading, glandular-hairy leaves, almost circular and deeply cordate, withering before the flowers appear. The maroon peduncle is 150-250 mm tall, terminating in a sparsely-branched panicle of greenish-yellow flowers.

T. pearsonii (Schönl.) Tölken (*Cotyledon pearsonii*, *C. luteosquamata*): Widely distributed from south-western Namibia through Namaqualand to Vanrhynsdorp. Usually only one stem up to 150 mm long develops from the thickened caudex. When the leaves fall short white phyllopodia remain, replaced by brown peeling bark in the older stem. The leaves are linear to linear-lanceolate, 15-40 mm long, acute, terete to flat, usually glabrous, greyish-green, brown-striped. The inflorescence has up to three monochasia with 2-5 flowers, buds pendulous, the peduncle 60-100 mm; corolla glandular-tomentose to pubescent, pale brown, co-

rolla tube 12-14 mm, the lobes short, recurved at the apex. The plants somewhat resemble *T. reticulatus* subsp. *phyllopodium* but are distinguished by the longer corolla (15-18 mm) and pendulous buds.

T. similis (Tölken) Tölken (*Cotyledon similis*): The distribution as given by Williamson in a study of dimorphism in this species (*Aloe* 34(1 and 2), 1997) is as follows: well populated colonies are only found on the Namibian side of the Orange River about 50 km from the sea, otherwise isolated uncommon plants occur from the Aurusberge in Namibia to the highlands of the Richtersveld, and southwards as far as Garies. In the same report plant dimension is given as variable between miniatures 10-30 mm high on the mountains to 210 mm in the fog-swept lower Orange River valley. The underground tuber produces one tortuous, slender, erect stem to 120 mm high, grey with black vertical ridges; leaves elliptic to oblong, c. 10 mm long, nearly terete, glabrous, shining green to matt grey-brown, often red-striped and with a median dorsal furrow. The slender stems are similar to those of *T. tenuis*. Inflorescence has a glabrous peduncle with, usually, a single flower; corolla tube pale yellow-green, with fine hairs in the throat. Tölken puts the flowering period at September-October, whereas Williamson gives it as March to April.

T. bleckiae Williamson: A shade species found on south-western mountain slopes north of Rosh Pinah in Namibia and in the northern Richtersveld. The tuberous base seems to spread laterally, from which many erect, unbranched stems arise, 30-70 mm long, red-streaked on green, with minute black rudimentary leaves. Three to seven leaves cluster at the apex of the stem, green and red-streaked with a median channel and 6-8 mm long. The peduncle is 10-12 mm, glandular-hairy, flowers 12 mm long, (in late summer), corolla tube green, with fairly short, spreading-recurved lobes, whitish-pink, streaked, the nectaries light yellow. According to Williamson the plants are related to *T. buchholzianus* which grows exposed, in coastal areas; but the latter has branching, glabrous stems; and to *T. schaeferianus*, also of the coastal strip, which is very similar, but has a completely or nearly glabrous inflorescence.

T. schaeferianus (Dinter) Tölken (*Cotyledon schaeferiana*): In the coastal region from Lüderitz Bay in Namibia to immediately south of the Orange River mouth in the Richtersveld. The underground tuber



Tylecodon schaeferianus

puts up one to several very short stems with light coloured, fissured bark, bearing crowded, egg-shaped, swollen greenish leaves, irregularly marked in red. In the natural state the plants form dense mats. The inflorescence has one or two glabrous flowers; the peduncle 15–40 mm high, the corolla tube is funnel-shaped, yellowish-green, the recurved lobes violet or pink. The species can produce dense mats like those of *T. decipiens*, but is distinguished by its thinner stems and glabrous flowers.

T. aurusbergensis Williamson: On the southern face of the summit of the Aurusberg about 60 km north of the Orange River in Namibia. The underground tuber (20 × 15 mm) gives rise to one (or two) erect stems to 80 mm high. The narrow stem is pruinose and covered with phyllopodia; the few dark green, glandular-hairy, obovate leaves are terminal, 10–15 mm long, flattened. The corolla tube is yellowish-green, 12 mm long, widening towards the mouth, the recurved lobes pink, anthers purplish-brown.

T. aridimontana Williamson: On the summit of Heioab Mountain in the central Sperrgebiet, southern Namibia; no further distribution given. Several thickened stems arise from a thickened base, about 45 mm tall. The stems have leaf scars but no phyllopodia. Leaves are sessile, narrowly ovate and slightly folded along their length, densely glandular-hairy, usually in threes at the apex or on short branches from a main axis. The inflorescence is pubescent, the peduncle of 12 mm is 1–4 flowered, flowers 12 mm long, corolla tube green, corolla lobes shiny pink and oblong-recurved.

1.2 Richtersveld (northern Namaqualand)

T. ellaphieae Van Jaarsveld [colour p. 93] (*T. cremnophilus*): Rosyntjie Mountain in the northern 'bulge' of the Richtersveld from 600 m to near the summit at 1200 m, tightly wedged into rock layers on southern cliff faces. This is one of several species which have rudimentary leaves at the tips of protruding phyllopodia, regular leaves of shorter duration also develop. The stems are 20–50 mm tall from a globose caudex, in season having a few large apical leaves, ovate to spatulate, fleshy, 20–70 mm long but sometimes broader than long; glandular-pubescent, leaving a conspicuous scar on falling. The inflorescence is 60–120 mm dividing into two to many monochasia, carrying 5–15 flowers, all parts glandular-pubescent, the corolla tube 10–15 mm, green, the lobes white and spreading, the nectaries almost square, pale yellow.

T. mallei Williamson: On the southern aspect of the Kouefontein Mountains in the central Richtersveld. Most distinctive are the slender unbranched stems, only 3–4 mm thick, which develop from ovoid tubers 25 mm long; the stems reach lengths of 250 mm, rooting and forming more tubers when the situation allows. The terminal leaves are flattened, spatulate, convex above, petiolate, glandular-hairy and take up a horizontal position. The stem is pubescent and covered by the long decurrent leaf bases of the deciduous leaves. The peduncle (10 mm) and all parts of the flowering system are hairy; the flowers greenish-yellow, pedicellate, the corolla tube with a central constriction, filaments fused to the tube for half of their length, the nectaries narrow, erect and closely aligned with the carpel base.

T. longipes Van Jaarsveld & Williamson: North of

Lekkersing in the Richtersveld. The plants form dense mats with fibrous roots in crevices of the south-facing slopes in Spitskloof. The stems branch underground from a short base and are more or less erect, in crowded clusters, up to 30 mm high and about 6 mm thick, the bark pale grey and peeling. At the apex of the stem 1-3 elongated, petiolate, spatulate to lanceolate leaves develop, densely glandular-hairy. Also present on the very uneven stem are minute rudimentary leaves, or scale leaves, which soon dry out and persist. The peduncle (10 mm) is usually single-flowered, the corolla tube (10 mm) is lime-green, the recurved lobes pink and white, flowers appearing in January in cultivation. The plants are related to the mat-forming *T. decipiens* which is south of Port Nolloth, and *T. torulosus* which occurs south of Lekkersing.

T. bayeri Van Jaarsveld: On south-facing ridges in the eastern Richtersveld, from Eksteenfontein to Kristalberg. This small species has a tuberous underground body with only several erect to decumbent stems 20-100 mm long. The stems have prominent truncated phyllopodia; grit sticks to the stem surface. The leaves are green, spatulate-obovate, flattened, 10-25 mm long, glandular-hairy. The peduncle is 5-25 mm high, bearing 1-4 yellow flowers in January; the corolla tube is 15 mm long, expanding in the upper half, glandular-hairy, the lobes recurved.

T. boddleyi Van Jaarsveld: On south-facing cliffs of the Oograbies Mountains in the south-western Richtersveld. The plants are wedged between severely layered rock and in rocky pockets. The species has a relatively large partly exposed caudex (60 mm in diameter) which gives rise to branching stems 30-100 mm tall. The habit is well illustrated by Elise Boddley within the description of the species in *Cact. & Succ. J. (US)* 64 (1992). The caudex has brownish-yellow bark which peels away in large flakes. As in *T. paniculatus* and *T. similis*, the terminal divisions of the flowering axes are reflexed. Another distinctive feature is the segmented or jointed appearance of the stems, greyish-green at first, becoming black. The leaves are elliptic to obovate, 8-20 mm long, glabrous or slightly hairy. The inflorescence is up to 40 mm in height, with forking branches, reflexed and ascending, the erect white flowers about 15 mm long, the corolla tube yellowish-green, all parts being glandular-hairy, with long dense hairs on the recoiling corolla lobes. Flowering from January to February.

1.3 Namaqualand (south of the Richtersveld) and Bushmanland (some species extend into the Richtersveld)

Namaqualand stretches from the Orange River in the north to the Olifants River in the south. It includes the Richtersveld, a mountainous arid area, of which Port Nolloth, Steinkopf and Vioolsdrift are the southern and eastern limits; the Sandveld (a coastal band about 30 km wide); the Rocky Hills which have round granite hills set on plains and extend from south of Steinkopf to just south of Bitterfontein and about 50 km wide, with a rainfall of 100-200 mm per annum; and the Knersvlakte which lies between Bitterfontein and Vanrhynsdorp, an area renowned for its white quartz plains and very saline soils (Le Roux & Schelpe in *Namaqualand* 1988).

T. decipiens Tölken: Has a restricted distribution near Grootmis in Namaqualand. Usually forming dense mats from a much-branched swollen base, the bark on older branches white and peeling; in nature the branches do not elongate much and are, according to Tölken, similar to the form of *T. schaeferianus* which was described by von Poellnitz as *Cotyledon sinus-alexandri*. Leaves oblanceolate to elliptic, 4-12 mm long, 3-8 mm broad, grey-green, with obtuse apex and distinct median groove; older leaves glabrous. Thread-like peduncle up to 20 mm long covered with glandular hairs, the inflorescence monochasial with one or several flowers, the corolla tube yellowish-green, the recurved lobes 4-5 mm long, pink.

T. occultans (Tölken) Tölken [colour p. 93] (*Cotyledon occultans*): A very small geophyte described in 1978 from near Bitterfontein at the northern end of the Knersvlakte, but also found in the Steinkopf area, about 170 km to the north. In both areas the species grows on flat or sloping quartzite gravel. The plant body, a tuber up to 60 mm long with a few short stems, is underground, from these stems a solitary leaf or several peltate, spatulate to orbicular dark green leaves arise, slightly grooved above, densely hairy with erect trichomes. The inflorescence appears from February to March (Tölken 1985), is 8-15 mm high, glandular-pubescent with 1-3 pale greenish-yellow flowers, the corolla tube 6-8 mm long, the lobes recurved and recoiled. The nectar glands (squamae) are oblong and yellow. Eleven years later **T. pusillus** [colour p. 93] occurring within a 30 km radius north-west, north-east

and south of Steinkopf was described by Bruyns. It also grows on flat quartz patches and has a short underground stem with horizontal thick roots, 2-5 leaves which are adpressed to the soil, reniform-orbicular with a slight central groove, dark green, with transparent trichomes. It is described as being similar vegetatively to *T. occultans*, with the exception that the leaf of the latter is thicker, and the transparent trichomes are simple, not cordate as in *T. pusillus*. Bruyns maintains that the corolla of *T. pusillus* is pubescent inside the corolla tube, especially hairy on the adaxial surface of the lobes, which are yellowish-green; in *T. occultans* the corolla tube is glabrous within and red-striped without (*S. Afr. J. Bot.* 55(3), 1989). Then, another 10 years later, *T. peculiaris* Van Jaarsveld is described from the northern Knersvlakte, also growing on flat quartz plains. It has a tuber 18-35 mm long, 15-25 mm diameter, bearing horizontal roots. A short single stem produces one orbicular-ovate thickened leaf, 12-16 mm × 10-15 mm and 8-10 mm high with a deep groove. The leaf surface is ridged, with purple epidermal cells bearing spherical white translucent trichomes. The erect peduncle is up to 45 mm tall, bearing 1-3 cream yellowish-green flowers which appear in February-March (*Aloe* 35(1), 1998). It is certainly further removed from *T. occultans* than *T. pusillus*, but nevertheless there are many common features. Discomforting is that while Tölken describes the flowers of his species as yellowish-green, the flowering period as February-March, both of these observations are refuted separately by the other two authors. Here we have a complex of very cryptic plants which share important characters but exhibit slight to moderate variation; further investigation of the 'quartz patch' communities may throw more light on their relationships.

T. sulphureus (Tölken) Tölken [colour p. 94] (*Cotyledon sulphurea*): Var. *sulphureus* occurs from Pofadder to Goodhouse in Bushmanland in the Northern Cape. The plants have fleshy, glabrous stems up to 20 mm long with underground tubers. Leaves oblanceolate to spatulate, up to 25 mm long, slightly grooved above and convex below, green, glabrous. Inflorescence flat-topped, glandular-hairy, corolla tube about 10 mm long, hairy and sulphur-yellow, the lobes recurved at the apex. The flowers appear in November-December whereas the closely allied *T. occultans* flowers in February-March; this, and the fact that its seeds lack the vertical ridges present in the seeds of *T. occultans*, are

distinguishing factors. *T. sulphureus* var. *armianus* Van Jaarsveld occurs south of the Orange River from Dabenorisberg to Pellaberg further east, on shady south-facing cliffs in these mountains. The tuberous rooted plants with pale pink flowers form dense clusters in rock crevices. The tuber has peeling bark, the stems 20-30 mm long with short phyllopodia (in the illustration (Plate 1984, *Flowering Plants of Africa*) there appear to be rudimentary leaves but these are not mentioned in the description). The leaves are linear to oblanceolate, 8-25 mm long, with dorsal groove, green with red spots. Peduncle 10-15 mm, glandular-hairy, corolla pale pink and green, 10-14 mm, the tube bulging at the middle, lobes lanceolate, spreading, with maroon striations. The stamens are in two series, 6 and 8 mm long. Flowering in January. The typical variety is further west, and has sulphur-yellow flowers in November and December.

T. atropurpureus Bruyns: Common but localised among *Pteronia incana* shrubs north-west of Springbok. The underground plant body is 30-120 mm long, cylindrical with thick roots and peeling brownish bark; there are several erect stems which are not visible aboveground and which produce 8-10 flattish orbicular to spatulate green leaves, sparsely hairy. Inflorescence 150-300 mm tall, with 2-4 monochasia, bearing 8-20 yellowish flowers, all parts glandular-pubescent, except the inner surface of the corolla tube, corolla lobes reflexed, deep maroon. Nectaries rectangular, translucent-white.

T. tuberosus Tölken: Namaqualand: near Steinkopf, in the shade of rocks. A densely branched fleshy base puts up erect aerial stems 20-40 mm tall with yellow bark and phyllopodia; leaves elliptic to lanceolate-spatulate, 30-50 mm long, 8-16 mm broad, glandular-hairy, grey to blue-green. All parts of the inflorescence are glandular-hairy. The peduncle is pale brown, flowers brownish, the corolla tube is 8-10 mm, almost glabrous within, the lobes 5-7 mm, brown with dark veins.

T. pygmaeus (W.F.Barker) Tölken: Common on quartz gravel in the Knersvlakte from Koekenaap to north-east of Bitterfontein. The tuber is hard, with pinkish-brown flesh, covered with thin layers of brown bark. The single (rarely more) stem is robust, 5-10 mm thick and from 50-200 mm in height, the younger stems smooth, without phyllopodia. The leaves are linear-oblanceolate, obtuse-ended, densely covered with cordate (heart-shaped)

trichomes. The peduncle is 30-50 mm long, purplish-brown, with 1-3 monochasia, each with 1-3 inconspicuous flowers; the corolla nearly glabrous, the corolla tube urn-shaped, short, only 4-6 mm long, pale yellowish-green, the lobes recurved. The nectaries are almost square, with abaxial median groove, brilliant red. Tölken's var. *tenuis* for the weaker-stemmed plants in the same locality has been elevated to species level (Bruyns in *S. Afr. J. Bot.* 58(1), 1992) and is described below, where a comparison is drawn.

T. tenuis (Tölken) Bruyns (*T. pygmaeus* var. *tenuis* (Tölken) Tölken): On quartz gravel in the Knersvlakte from Koekenaap eastwards along the Hol and Sout Rivers. In this species the tuber is smaller and softer than in *T. pygmaeus*, with white flesh and lacking peeling bark. The stem is very slender, 2-3 mm in diameter, compared to 5-10 mm in *T. pygmaeus*, and tends to zig-zag, probably obtaining support from the shrublets under which it grows, unlike *T. pygmaeus* which grows in the open. In the latter the young stems are smooth without phyllopodia, in this species the leaf leaves behind a distinct phyllopodium. The leaf trichomes are oblong, not cordate as in *T. pygmaeus*. The inner surface of the corolla tube of *T. tenuis* is red-striped on pale green, the filaments are joined to the tube for most of their length and the longer nectaries are pale orange-yellow. Comparative line illustration is given by Bruyns with the description of his new combination in *S. Afr. J. Bot.* 58(1), 1992.

T. scandens Van Jaarsveld: Near Rooiberg in the northern Knersvlakte, Namaqualand. Of all the dwarf tylecodons, this is the strangest. The obligatory tuber is there, 40 × 15 mm, from which there is a solitary, thin, zigzagged stem up to 160 mm long, with distant, downward-directed phyllopodia, one at each angled turn of the black stem; these projections act as hooks to support the stem on surrounding shrubs. The young stem is green and densely pubescent, the narrow leaves ascending, 6-8 mm long, densely hairy. The inflorescence consists of a single monochasium with 1-3 erect flowers, held on arcuate-ascending pedicels which are 30 mm long, all parts glandular-pubescent. Corolla is 10 mm long, green, lobes spreading, green with red lines. The floral characters are close to *T. tenuis*, also scandent and on the Knersvlakte, but the long pedicels and peculiar phyllopodia set *T. scandens* apart.

T. fragilis (R.A.Dyer) Tölken (*Cotyledon fragilis*):

Known only from near Strandfontein on the coast of Namaqualand. The small tuber produces several smooth stems 30-40 mm tall which have flaking bark. The leaves are linear, 15-25 mm long, terete to slightly grooved, glabrous. The inflorescence with 1-4 monochasia; the peduncle green, 30-80 mm, 1-8 crowded yellowish-green flowers appearing from August to September.

T. cordiformis Williamson: Plants grow in rocky fissures on the southern Harrasberg south-east of Port Nolloth in northern Namaqualand. It was named for its heart-shaped leaves which are pedicellate, dark green, shiny and covered with white transparent hairs. Its affinities are apparently with *T. bayeri*, but it has a larger tuber, 50 × 20 mm, the shorter stems are thicker and have pubescent phyllopodia. The wiry peduncle is 10 mm long, with one or two pubescent flowers in January. The corolla tube is pale green, 10 mm long, the corolla lobes are yellowish, spreading-recurved, and densely pubescent on the lower surface.

1.4 The southern karoo region

This regional section includes species in the Ceres Karoo, the Little Karoo and the south-western Great Karoo.

T. leucothrix (C.A.Smith) Tölken (*Adromischus leucothrix*, *Cotyledon swarbergensis*): Plants select the shaded aspect of south-facing Swartberg foothills and rocky hillsides from Ladismith to Vanwyksdorp in the Little Karoo. The underground tuber produces one to several erect or decumbent smooth stems 40-150 mm long, with pale flaking bark. The linear green leaves are crowded at the stem tips, flattened with a deep median groove, 15-40 mm long, all surfaces with dense white hairs. The inflorescence is glandular-tomentose, few-flowered, the peduncle 100-200 mm, the corolla tube yellowish-green, the lobes pinkish-white.

T. faucium (V.Poelln.) Tölken (*Cotyledon faucium*): On shaded rock faces in the mountains south of Sutherland in the western Great Karoo. Dwarf plants in which the tuberous base is shallow-rooted and has short erect stems up to 40 mm with the old leaves persistent for some time on conspicuous phyllopodia. The leaves are oblanceolate to spatulate, 15-35 mm long, flattened with a dorsal median groove, glandular-hairy, green or greyish-green.

The inflorescence has 1-3 monochasia, few-flowered, glandular-hairy, the peduncle 150-300 mm tall. The flowers have a yellowish-green tube and recurving pink corolla lobes with dark pink veins.

T. stenocaulis Bruyns: South-western region of the Ceres Karoo in the south-western Cape. A slender-stemmed plant which has a swollen tuber 60 mm deep and 25 mm thick, from which a few stems (or many from older tubers) develop, 30-150 mm in length, with many leaves; the leaf has a rounded apex and tapers to a narrow base, 12-30 mm long, flattened, erect, almost glabrous, reddish-green. The peduncle is 50-70 mm, with 3-5 glandular-pubescent flowers, pale green, striated with maroon, the corolla tube 12 mm, widening at the mouth which is dark-veined, the corolla lobes ascending before recurving. The flowers are similar to those of *T. faucium* which is distinguished from this species by its stout phyllopodia and its longer peduncle which is 150-300 mm tall.

T. albiflorus Bruyns: Localised between Montagu and Barrydale in the Little Karoo. The plants occur near the top of south-facing ridges in *renosterveld* (*Elytropappus rhinocerotis*) and are shallow-rooted. The short stems from a thickened base are 10-60 mm tall, with shiny, yellow peeling bark. The leaves do not break off cleanly and so persist for about a year. The numerous green leaves are elliptic-spathulate, 10-20 mm long, flattened, densely covered with transparent trichomes. The inflorescence is glandular-pubescent, with 1-6 fairly large greenish-white flowers which have faint reddish stripes. The corolla tube is 12-15 mm, with a funnel-shaped mouth, the lobes long (10 mm) and spreading, the squamae elongated and pale green.

2 Medium to large shrubs with several to many stems

2.1 Namibia

There are no medium to large shrubs endemic to Namibia, in fact, most of them have their larger distribution in western South Africa.

T. wallichii (Harv.) Tölken [colour p. 94]: This is a robust shrub 300-800 mm high with a great range from near Aus in southern Namibia to the Little Karoo in the Western Cape. The typical subsp. occurs from Kamieskroon in Namaqualand south-

wards into the karoo areas. North of Kamieskroon and into Namibia the plants change: the inflorescence becomes glabrous and the length of the corolla shortens. The northern plants fall under subsp. *ecklonianus* (Harv.) Tölken (*Cotyledon eckloniana*, *C. dinteri*) in which the glabrous flower is distinctive, but Tölken comments that the corolla length of 5-8 mm is variable. In subsp. *wallichii* the peduncle, pedicel and flower are glandular-pubescent, even tomentose, and the corolla tube is 7-12 mm long. A more detailed description of the plant is given under plants of the southern karoo.

T. rubrovenosus (Dinter) Tölken (*Cotyledon rubrovenosa*): Occurring on both sides of the Orange River the species is present in southern Namibia and in Bushmanland in the Northern Cape, continuing on rocky slopes in the river region as far as Prieska. Small shrubs up to 350 mm tall, the short, thick branches are covered with phyllopodia which later disappear with the peeling bark; the leaves are linear, 25-40 mm long, terete or grooved dorsally, acute, greyish-green, often striated. All parts of the inflorescence glandular-pubescent, the peduncle 60-120 mm long, pale yellow, with 20 or more nodding yellowish-green flowers which appear from September to October.

T. paniculatus (L.f.) Tölken [colour p. 94] (*Cotyledon paniculata*, *C. spuria*): Isolated in the Aua Mountains in central Namibia and also in the southern region, common in northern Namaqualand and the southern karoo. It seems to have wide tolerance, growing in rocky elevations (like most tyledons) and yet it is found in sand along the western and southern Cape coastline. The plants grow to heights of 1.5 m, making them the largest of the tyledons, and also unsuitable for desert areas in Namibia. Its characters are described under its entry in the southern karoo plants.

T. racemosus (Harv.) Tölken [colour p. 94] (*Cotyledon racemosa*, *C. chloroleuca*): From Witputs in southern Namibia to the Richtersveld and Steinkopf in northern Namaqualand, in ravines and rocky outcrops. Sparsely branched erect plants 200-400 mm in height. The stems are covered with old leaves which later peel off with the bark. The leaves are very variable: linear-obovate to orbicular, acute to obtuse, glandular-pubescent to glabrous. At Lekkersing in the Richtersveld the leaves are as broad as in the Lüderitz plants which were described as *Cotyledon chloroleuca*. Inflorescence is 50-100 m,

the flowers pale green, the recurved lobes pinkish-white, flowering from September to October.

T. reticulatus (L.f.) Tölken [colour p. 94] (*Cotyledon reticulata*): Subsp. *reticulatus* has the greater distribution, occurring in the Karas Mountains in southern Namibia, widespread from Port Nolloth to Bushmanland, and southwards. Subsp. *phyllopodium* Tölken extends from Witputs in Namibia to near Komaggas south-west of Springbok in Namaqualand, associated with rocky terrain. Sometimes the two subspecies occur near each other but no intermediates have been observed. Fleshy, stumpy, and yet attractive shrublets 200-300 mm high; leaves linear, terete and dorsally grooved, yellowish-green. Subsp. *phyllopodium* has narrower young branches which are covered with phyllopodia with leaf scars which are visible for several years. The flowers are almost erect. See entry under Namaqualand.

T. hallii (Tölken) Tölken (*Cotyledon hallii*): Present from Rosh Pinah in southern Namibia to south of the Orange River at Vioolsdrift in northern Namaqualand, on exposed gravel slopes. The plant's stem is 50 mm thick at the base, narrowing to 250 mm tall, well-branched towards the apex with smooth stems and flaking bark. Leaves linear-lanceolate, 8-35 mm long, terete or dorsally grooved, acute, shortly pubescent or glabrous. Peduncle 15-35 mm, flowers glandular-pubescent, yellowish-green tinged with brown.

T. buchholzianus is present in the coastal strip of south-western Namibia near the lower reaches of the Orange River; it is described with the Richtersveld species below.

2.2 Richtersveld

T. buchholzianus (Schuldt & Steph.) Tölken (*Cotyledon buchholziana*): Present in the coastal region from south-western Namibia to the Richtersveld in the areas near the Orange River mouth.

The caudex is slightly thickened, with many well-branched pale stems, side branchlets usually short, nearly always leafless, the bark flaking. Leaves linear-terete, 5-15 mm long, curving upwards, glabrous. Peduncle about 10 mm long usually with a solitary flower, glabrous, pink to red, the tube 13 mm, lobes recurved. Flowering from January to March. Var. *fasciculatus* is present on the



Tylecodon buchholzianus

eastern slopes of mountains east of Port Nolloth in Namaqualand. It is distinguished by its low, spreading habit, becoming pendulous in its steep habitat. The typical variety is erect to about 200 mm.

T. kritzingeri Van Jaarsveld: Known only from the north-west aspect of the Oemsberg in the northern Richtersveld. The divided underground tuberous body puts up one slender stem which scrambles and climbs to a length of 1 m. This glabrous species has several amazing distinctive characters: the linear leaves recoil and act as tendrils; the inflorescence spreads terminally to 200 mm in diameter, with relatively few, large, funnel-shaped, maroon flowers which have erect-spreading corolla lobes. The opened flower lasts for about 8 days. Lastly, Van Jaarsveld records that it is the fastest growing member of the genus – producing stems 700 mm long in one season under controlled conditions.

T. viridiflorus (Tölken) Tölken (*Cotyledon viridiflora*): In sheltered positions near Modderfontein and Helskloof in the Richtersveld. Shrublets with a few brittle, fleshy branches erect to 350 mm, hairy at first, later glabrous. Leaves oblanceolate, 20-40 mm long, hairy when young. Inflorescence spike-like with 3-5 flowers, corolla tube up to 20 mm long, covered with recurved hairs, the corolla lobes recurved, yellow-green. Flowering from December to January.

T. striatus (P.C.Hutch.) Tölken (*Cotyledon striata*): In the mountains of the Richtersveld west of Vioolsdrift but mainly from south of the Kamies-

berg in Namaqualand. The irregular tuber produces several erect stems up to 250 mm, the younger stems striated. The old leaves remain attached to the decurrent leaf bases, true phyllopodia absent. The leaves linear, hairy, 30-50 mm, acute, terete or dorsally grooved. Inflorescence 200 mm tall, glandular-pubescent, bearing 10-15 erect flowers, corolla yellowish-green, tinged with purple, the lobes red-veined.

T. torulosus Tölken [colour p. 93]: Known only from Karrachab Poort south of Lekkersing in the Richtersveld. Shrublets with erect branches up to 250 mm tall. The name, meaning torulose, refers to the swollen nodes on the stems left by the leaf bases, the bark brown, later white and peeling. Leaves ovate-spathulate, 20-35 mm long, apices usually recurved, densely hairy, grey to blue-green. Peduncle and pedicels hairy, corolla tube 18-23 mm long, hairs between petals, yellowish-green.

T. racemosus also occurs in the Richtersveld; it is described with the fore-going Namibian species.

2.3 Namaqualand (some species extend into the Richtersveld)

T. hirtifolius (W.F.Barker) Tölken (*Cotyledon hirtifolia*): Known only from shaded areas on rocky slopes from Komaggas to Spektakel Pass in Namaqualand. A much-branched shrublet up to 200 mm, the stems covered with long persistent phyllopodia. Leaves oblanceolate to obovate, 40-60 mm long, dorsiventrally compressed, densely glandular-pubescent. Inflorescence with two or three long branches, each with 5-10 glandular-tomentose yellowish-green flowers, the corolla lobes spreading, white to pale yellow; flowering in November.

T. suffultus Bruyns ex Tölken: Known from only one locality near Vanrhyn's Pass in Namaqualand. A scrambling species with slender, procumbent branches up to 300 mm long with tuberous roots. Leaves dark green, linear-elliptic, 10-20 mm long, acute, grooved above, convex below. The inflorescence is sparsely glandular-pubescent. The peduncle (20-50 mm) and pedicels are covered with glandular hairs; corolla tube 5-6 mm long, glandular-hairy and yellow-green, corolla lobes 4-5 mm long, pink, fine hairs inside tube.

T. reticulatus (L.f.) Tölken [colour p. 94] (*Cotyle-*

don reticulata): Stumpy shrublets 200-300 mm tall, the short thick stem dividing into branches with subterete leaves at their tips and bearing the dried twiggy remains of old inflorescences. Subsp. *reticulatus* occurs in Namaqualand, Bushmanland, Tanqua Karoo and southern Great Karoo as far east as Willowmore. The young branches are more than 10 mm thick and very short, the leaf scars disappearing annually with the peeling bark. Leaves are linear or oblanceolate, 15-35 mm long, terete or grooved above, or flattened with the margins lifted. The inflorescence is rigid; the flowers yellowish-green, and may be tinged with brown or purple. Subsp. *phyllopodium* occurs from Komaggas to south-western Namibia. The young branches are longer and thinner, covered with phyllopodia, the round leaf scars being visible for several years; inflorescence brittle, flowers almost erect.

T. wallichii and **T. paniculatus** both occur in Namaqualand and are described under plants in the western and southern karoo. **T. striatus** which is entered with the Richtersveld species also occurs in southern Namaqualand.

2.4 South-western Cape and southern karoo areas

T. grandiflorus (Burm.f.) Tölken (*Cotyledon grandiflora*): Present in the south-western Cape, on the Cape Peninsula and in the mountains west of Clanwilliam. The plants reach a height of about 400 mm, the stems nodular with persistent phyllopodia with old leaves remaining attached.

Leaves linear-lanceolate, about 70 mm long and up to 10 mm across, withering before the flowering period. Inflorescence up to 500 mm tall, flowers erect, orange-red, corolla glandular-pubescent, the slender corolla tube (30-35 mm long) curved upwards.

T. wallichii (Harv.) Tölken [colour p. 94] (*Cotyledon wallichii*): Robust shrublets 300-800 mm tall; leaves subterete, 50-100 mm long, leaf bases persisting and forming prominent phyllopodia; inflorescence 350-700 mm tall with many nodding pale greenish-yellow flowers. Apparently, poisonous to stock. Subsp. *wallichii* extends from near Kamieskroon in Namaqualand along the mountains to near Oudtshoorn in the Little Karoo. The peduncle, pedicels and flowers are densely hairy and the corolla tube is 10-12 mm long. Subsp. *ecklonianus* (*Cotyledon eckloniana*, *C. dinteri*) occurs from north of

Kamieskroon to Aus in Namibia; the peduncles, pedicels and flowers are glabrous or nearly so; the corolla tube is 5-8 mm long. In both *T. wallichii* and the closely related *T. cacalioides* the phyllopodia vary greatly in length. The two species cannot be distinguished unless in flower; the flowers of *T. wallichii* are shorter.

T. cacalioides (L.f.) Tölken [colour p. 94] (*Cotyledon cacalioides*): Little Karoo. The stems branch erectly to 1 m, and are covered with spirally arranged, projecting, persistent phyllopodia. The leaves are linear, 30-70 mm long, glabrous, greyish-green or brown. The handsome inflorescence is 300-600 mm tall, the erect, yellow buds easily distinguish it from the greenish-yellow, spreading and nodding flowers of *T. wallichii*. The corolla tube of *T. cacalioides* is 17-25 mm long and sulphur yellow, the inside having fine hairs; the corolla tube of *T. wallichii* is 10-12 mm long. Both species occasionally hybridise with *T. paniculatus*; both are apparently poisonous to stock.

T. paniculatus (L.f.) Tölken [colour p. 94] (*Cotyledon paniculata*): The well known *botterboom* which is the largest member of its genus and the most widespread, from Namibia to near Steytlerville in the Eastern Cape. Like most *tylecodons* it keeps to the mountains along the west and south, but is also found along the coastline. It has almost tree-like habit, with a thick trunk, 0.6 m in diameter, and up to 2 m tall. The soft stem is covered with papery yellowish bark which peels. The fresh green succulent leaves are obovate, 60-120 mm, flattened, pubescent to glabrous. The inflorescence has 3-6 monochasia, each with 4-10 brick-red, nodding flowers, the red peduncle 80-150 mm. The corolla tube is 12-16 mm, the long lobes recurved or recoiled, orange with a spotted throat. In the veld the plants tend to be in groups, making splashes of red in the summer when they bloom.

T. ventricosus (Burm.f.) Tölken (*Cotyledon ventricosa*): From western coastal areas south of Vanrhynsdorp to the Little Karoo, also on the mountains of the Great Karoo as far as Graaff-Reinet in the Eastern Cape. One to many erect stems up to 300 mm develop from the tuberous base. Old leaves remain on the phyllopodia. Leaves linear, 30-60 mm long, acute, flattened, hairy or glabrous, green or yellowish. The peduncle is 150-300 mm, the flowers tomentose to pubescent, the corolla tube dilated at the middle, 16-19 mm long, yellowish-

green with purple veins. The species is variable, some populations limited to one stem, some have many short stems, others long stems.

T. reticulatus occurs in the Tanqua Karoo, the southern Great Karoo and Little Karoo as far east as Willowmore; it is described with the Namaqualand species.

Adromischus Lem.

Common name: 'Bont plakkie' – in reference to the colourful mottled leaves typical of many of the species. In 1852 Lemaire separated the new genus from *Cotyledon* and divided the species of *Adromischus* into two groups. Several attempts were subsequently made at re-classification, including Uitewaal's arrangement based on floral structure in 1952 and 1963. In 1970, Jacobsen emended the classification by von Poellnitz, adding a subsection of his own. The most recent revision of the genus by Tölken first appeared in 1978 and again later in *Flora of Southern Africa* (1985) in which he adopts a five-sectional system which is adhered to in the following notes.

In 1998 *Adromischus* by Pilbeam, Rodgers and Tribble appeared as *The Cactus File Handbook 3*; this is aimed at the collector and is written in an informal style and provides an extension of field information since Tölken's revision. Most useful are the distribution maps and photographs of plants in habitat.

For succulent growers who lack space, *Adromischus* is probably the most attractive prospect among the Crassulaceae. Invariably small, compact shrublets, their leaves are decorative, the inflorescence a narrow spike of erect or spreading pink, deep rose or whitish flowers. As in *Cotyledon*, the bracts on the peduncle are entirely distinct from the leaves, which are spirally arranged, stiff and persistent.

1 Section Adromischus Jacobsen

Straight inflorescence with flowers at almost right angles to the peduncle. Corolla tube green to reddish-green, glabrous; the corolla lobes broad at base and immediately constricting into short points with frilled and undulate margins, mostly white or pink; the stamens exerted to just beyond the mouth of the tube. Included are eight species from the

south-western Cape to south-west Namibia, with one in the Eastern Cape.

A. filicaulis (Eckl. & Zeyh.) C.A.Smith: In subsp. *filicaulis* (*A. fragilis*), there is wide variation in leaf shape and size, from linear-elliptic and almost terete to flattened leaves which are oblanceolate, with or without dark spots. The typical subsp. extends from the Richtersveld to the Knersvlakte in western South Africa; the stems are erect or decumbent, rarely with fibrous adventitious roots. The flowering spike is 200-350 mm tall, corolla tube yellowish-green tinged pink, lobes broadly triangular, white or pale yellow, tinged from pink to deep red with mauve mucro. Subsp. *marlothii* (*A. marlothii*, *A. tricolor*) occurs well to the south from Worcester to Oudtshoorn in the Little Karoo, also in the Great Karoo mainly from Laingsburg to Beaufort West; the stem is prostrate with stilt roots, the leaves are linear elliptic and terete or nearly so. Apart from a locality preference and the presence of stilt roots there does not appear to be a substantial difference between the subspecies.

A. liebenbergii P.C.Hutch.: Near Laingsburg in the western Great Karoo. Embedded in rock cracks with fibrous roots; the stems decumbent up to 200 mm, the leaves dull greyish-green, not freckled, obtriangular, 15-20 mm long, with a distinct longish petiole up to 10 mm. The inflorescence is green, the peduncle 150-200 mm, with single-flowered cymes, corolla pale green, tinged red, the lobes broadly triangular, white to pale pink, the anthers exserted. It may be confused with *A. triflorus* which has similar leaves and occurs in the same area, but this species belongs to section *Inci-silobati*, and its corolla lobes are lanceolate, longer than broad and the anthers are included in the tube.

A. alstonii (Schönl. & Bak.f.) C.A.Smith (*A. triebneri*, *A. subrubellus*, *A. pulchellus*): From Witputs in southern Namibia southwards to Garies in lower central Namaqualand. Decumbent to prostrate branching stems up to 150 mm with fibrous roots. The leaves are oblanceolate, 40-80 mm long, rounded and flattened with a horny margin, greyish-green with bloom, sometimes purple-spotted. The flowering spike is 200-350 mm, corolla tube green tinged brown, lobes broadly triangular, white to pale pink with darker mucro, anthers exserted.

A. montium-klingshardtii (Dinter) Berger [colour

p. 94]: Coastal from the Klingshardt Mountains in south-western Namibia to Holgat River in the Richtersveld. Erect plants up to 200 mm with fibrous roots. Sessile, small, usually unmarked leaves, obovate to orbicular, 15-30 mm long, a horny margin encircling the leaf. The corolla tube is 11-13 mm long, green, lobes broadly triangular, pale yellow to white with pink mucro, anthers exserted. The small rounded leaves are like those of *A. hemisphaericus* but it is distinguished from the latter by its separate northern distribution, by the absence of broken wax on the leaves and its very short inflorescence (80-100 mm), the latter up to 400 mm tall in *A. hemisphaericus*.

A. hemisphaericus (L.) Lcm. (*A. rotundifolius*): Tölken's distribution put this flat-leaved species on the Cape Peninsula and from Caledon to Worcester in the south-western Cape. Pilbeam et al. include all the flat-leaved section *Adromischus* plants from Cape Town to the Knersvlakte in this species. The stems are suberect, becoming decumbent when reaching lengths of up to 250 mm. The leaves are oblanceolate to obovate, 15-25 mm long, greyish-green, with or without spots, flat or slightly convex above and convex below, with reticulate wax patterns, wax flaking. The inflorescence is 150-250 mm, corolla tube green, tinged brown, lobes broadly triangular with a few trichomes in the throat, white, tinged pink, darker at throat and mucro. This species is closely related to *A. roaneanus* but its stems are more erect and more robust than the thinner, zig-zagged stems of *A. roaneanus* which lies to the north on the edge of the escarpment. In the handbook *Adromischus* (1998) the point is made that *A. roaneanus* in collections (in England) originated from one introduction with the result that its form is accepted as typical of its species, when this may not be typical of the plants in the field.

A. roaneanus Uitewaal: Nieuwoudtville and Vanrhyn's Pass on the Bokkeveld Mountains, at the edge of, and below, the escarpment, just east of Namaqualand. The stem somewhat zig-zagging at the nodes, becoming prostrate and rooting; leaf-blade dorsiventrally compressed, varying from oblanceolate to obovate and obtuse to acute, often narrowing to a stalk, with a thick bloom and rarely purple-spotted. The peduncle is 250-380 mm tall, corolla tube pale green, the lobes broadly triangular, cuspidate, white tinged pink with darker mucro. Flowering November to December.

A. subdistichus Makin ex Bruyns: Prince Albert in the Great Karoo to Willowmore, and southwards to Uniondale in the Little Karoo, sometimes mat-forming on the summits of the hills. The young leaves are distichous at first, becoming spiralled. Erect to decumbent stems to 120 mm with fibrous roots. Leaves are obovate to orbicular, 12-27 mm long, with flattened upper surface, lower surface convex, horny margin encircling the leaf, surface non-waxy. Inflorescence to 140 mm, greenish-yellow with reddish stripes, lobes triangular with margins rolled dorsally, pink with median stripe. Although Bruyns compared it to *A. leucophyllus*, its flower places it in section *Adromischus*.

A. bicolor P.C.Hutch.: The only member of this section which occurs only in the Eastern Cape, in the neighbourhood of Steytlerville; also reported from widely separate Middelburg and King William's Town, the distribution is not clear. Tölken describes this species as having a tuberous base with short erect branches. Leaves obovate to orbicular with a short petiole, 20-30 mm long, greyish-green and densely spotted. Peduncle relatively short at 100-200 mm, the corolla tube yellowish-green, the lobes broadly triangular, white to pale pink with purple mucro. Flowering in December.

2 Section *Boreali* Tölken

Inflorescence straight with buds pressed to the axis until flowering. Corolla tube slightly grooved, glaucous-pink or red, the lobes (as in section *Adromischus*) are at least as broad as long, ovate to ovate-triangular, slowly tapering to a point with undulate margins; the stamens (as in section *Adromischus*) protrude slightly from the corolla tube, and a few club-shaped trichomes are present. Three species occur to the east, west and south of the Kalahari.

A. trigynus (Burch.) V.Poelln. (*A. subcompressus*, *A. rupicola*): In the Northern Cape from Pofadder in Bushmanland to the type locality at Griquatown; in the southern Free State and recorded from Steynsburg and Aliwal North in the Eastern Cape, always in shaded rock crevices. A very colourful species with deep maroon or red blotches on grey-green leaves. Many short stems develop from a tuberous base, the leaves obovate to orbicular, 20-30 mm long, flattened, with a complete horny margin. The inflorescence 150-250 mm tall, the buds 5-

angled and slightly grooved, at first adpressed to the axis. The corolla 10-13 mm, yellowish-green with a thick bloom, lobes ovate, rough, with trichomes in the corolla throat, cream tinged pink, anthers exserted.

A. umbraticola C.A.Smith: Unique in that this species has a Transvaal distribution, with subsp. *umbraticola* (*A. saxicolus*) present on the Highveld in North West Province (Potchefstroom northwards to Zeerust) and subsp. *ramosus* from Chuniespoort and extending on the mountains towards the Soutpansberg in the Northern Province. A tuberous base produces short erect stems 20-40(-100) mm long, leaves oblanceolate, 20-50 mm long, obtuse, flattened but somewhat convex on both sides, the distal margin horny, green to grey-green with a white, waxy bloom. The inflorescence spike is 150-250 mm tall with single-flowered cymes, buds erect and adpressed to the axis at first. Corolla pale green tinged pink, with bloom, the lobes white to pink with trichomes at the throat. Both subspecies flower in December. In subsp. *ramosus* the stems are longer and trichomes are absent at the corolla mouth.

A. schuldtianus (V. Poelln.) V. Poelln.: As presently known, this is the only *Adromischus* which is endemic in Namibia. Subsp. *schuldtianus* is widespread but uncommon in western-central and southern Namibia; subsp. *juttae* (*A. juttae*) is rare in the eastern Karasberg Mountains in southern Namibia. Like many *Adromischus* species, this one fills up rock fissures, but here the authors of the *Adromischus Handbook* (1998) present the astonishing information that the species filled up a crack for a 100 m; surely this must be submitted to the *Guinness Book of Records*. The tuber produces short, erect branches, leaves oblanceolate, 15-20 mm long, flattened, the margin horny in the upper half (often crimped, according to the *Handbook*), greyish-green, freckled or plain. Inflorescence spike 250-350 mm, the corolla tube pale green with a bloom, lobes whitish, deep mauve in the throat; anthers more or less included in the tube. Subsp. *juttae* is separated because of its stems 40-120 mm long, Tölken notes that even in shade the typical plants do not develop these long stems.

3 Section *Brevipedunculati* V. Poelln.

Inflorescence straight and often branched, corolla slightly dilated towards the mouth, slightly grooved

in the upper half, greyish-green, glabrous, the lobes up to three times longer than broad, spreading to recurved, usually with hairs on lobes and in the throat of the tube, anthers included or scarcely protruding. Most species have soft leaves and tuberous roots. There are six species one of which has pendulous flowers; in a genus which generally has insignificant flowers this section contains species in which the flowers are small but beautiful.

A. nanus (N.E.Br.) V. Poelln. (*A. pauciflorus*): In Northern Namaqualand north and west of Steinkopf, and west of Springbok. Jacobsen adds south of Aus in Namibia, this is not commented upon by Tölken, who described it from a very restricted distribution. It is a dwarf plant with short stems to 40 mm, leaves broad-ovate to almost orbicular, plain light green, soft, 6-14 mm long. The short brown peduncle carries one or two beautiful white and dark red flowers in November.

The corolla tube dilates slightly towards the mouth, and is greenish, the lobes 2-3 mm long, white with median reddish stripe, trichomes at the throat, anthers included in the tube. The species was first described as *Cotyledon nana* in 1901. In 1979 Tölken described the similar *A. diabolicus* from much the same area (Vioolsdrift to Pofadder in Bushmanland). This species has stems up to 10(-80) mm, the leaves the same size and shape as in *A. nanus* (in description, but not in the key (Tölken 1985). The peduncle is longer, 70-150 mm, green, with one to two flowers, the corolla tube pale yellowish-green, lobes spreading, white with a median mauve stripe, the anthers included. Because Tölken knew *A. nanus* from Steinkopf only, the full distribution from northern Namaqualand to Bushmanland needs to be investigated to establish the relationship here.

A. phillipsiae (Marloth) V. Poelln. [colour p. 94]: Peter Bruyns who is a notable botanical explorer prepared a map (*Aloe* 35(1), 1998) which gives the distribution of *A. phillipsiae* (in separate populations along the escarpment from Kamieskroon in Namaqualand to Laingsburg in the southern karoo), *A. humilis* and *A. fallax*. All three species occur along the edge of the escarpment in the western and southern Cape. *A. phillipsiae* is the only member of the genus to have pendulous flowers (as in *Cotyledon*). It is clump-forming with stolons, the leaves soft, 30-40 mm long, about 8 mm across, concave above and dark green. The inflorescence is 200-350

mm, with pedicels 15-35 mm long, the corolla tube of 18-20 mm dilates slightly at the middle, orange-red in colour, sometimes paler because of grey bloom, the lobes recurved, the anthers slightly exerted. Jacobsen created the subsection *Pendenti* for this species, but the subsection was not validly published.

A. humilis (Marloth) V. Poelln. (*Cotyledon humilis*, published in 1915): According to Bruyns both *A. humilis* and *A. fallax* occur on the eastern extension of the escarpment from Komsberg Pass to Beaufort West, and eastwards to Graaff-Reinet in the Eastern Cape. The trio, which includes *A. phillipsiae*, all share the "channelled, soft leaves, which are pliable and never form any kind of horny margin" (Bruyns 1998). *A. phillipsiae* is immediately separated florally, but the other two are very similar. *A. humilis* is described as a small plant, stems 10-20 mm long, leaves obovate to orbicular 10-15 mm long. Corolla 10-12 mm, yellowish-green, the lobes deep reddish-purple, but the description is of plants from near Beaufort West only. **A. fallax** Tölken is described as having decumbent stems up to 200 mm, leaves oblanceolate to elliptic, 20-40 mm long. The inflorescence is 200-300 mm, the lobes spreading, pink or purple. The description of *A. fallax* was from the type specimen and at that stage its further distribution was unknown.

A. caryophyllaceus (Burm.f.) Lem. [colour p. 94]: Occurring south of the Langeberg range from near Robertson to Mossel Bay in the Western Cape. Its synonyms (*A. jasminiflorus*, *A. grandiflorus*) as well as its own name 'like the carnation family' all pay tribute to its beautiful flowers which appear from January to March. One has to be familiar with the delicate pointed-petal flowers of the wild *Dianthus* of the Cape and elsewhere to appreciate why Burmann named it after the 'Pink' or 'carnation' family. The stems are erect or decumbent to 200 mm, the leaves linear-lanceolate, 10-35 mm long, tough, flattened, with horny, reddish margins. The inflorescence is 200-300 mm with branched peduncle, the corolla tube 18-21 mm, grey-green, the lobes 4-6 mm long, 15 mm across the top, plum-coloured with a generous white border, striking and the largest flowers in the genus.

4 Section *Incisilobati* Uitewaal

Inflorescence straight with flowers erect. Corolla

tube cylindrical usually green, glabrous, the lobes narrowly lanceolate, up to three times longer than broad, rough with club-shaped trichomes on lower part of lobes and in the throat of the tube, white to pale pink usually with deep mauve line along margin. Anthers included. The six species have an essentially southern distribution in the Western and Eastern Cape Provinces.

A. mammillaris (L.f.) Lem.: East of Calitzdorp in the Little Karoo. Decumbent stems up to 150 mm, leaves linear-lanceolate, slightly compressed to almost terete, grey-green or brownish, usually unmarked. The inflorescence 250-350 mm, corolla tube cylindrical 11-13 mm, greenish, the lobes triangular-lanceolate, about 5 mm long, rough, trichomes mainly at the throat, white with a mauve margin, anthers included. Flowering in December. The species has a confused taxonomic history and clearly nothing can be gained by pursuing it over some 217 years. The nipple-ended, terete-leaved plants should be tracked down in the veld and, if necessary, a lectotype selected.

A. triflorus (L.f.) Berger [colour p. 94] (*A. subcompressus pro parte*, *A. subpetiolatus*, *A. procurvus*): Common in the Little Karoo and adjoining areas (Worcester, Mossel Bay, the south-western Great Karoo). Decumbent stems to 200 mm, leaves variable, oblanceolate to obtriangular, 30-50 mm long, usually convex on both sides, horny margin in upper half, glaucous, often with red splotches mostly on the upper leaf. Inflorescence 250-350 mm with 1- to 3-flowered cymes, buds terete and curved at the apex. Corolla tube cylindrical 8-10 mm, yellowish-green, corolla lobes white or pink with purple margins, anthers included.

A. maculatus (Salm-Dyck) Lem.: On Langeberg Mountains from Worcester to north of George in the Western Cape. Decumbent stems to 150 mm long, leaves obovate to oblanceolate, 20-35 mm long, rounded or obtuse, with a complete horny margin around leaf, glaucous with dark splotches. Inflorescence 200-350 mm with 1- to 2-flowered cymes, buds terete and tapering, spreading. Corolla tube cylindrical, 8-11 mm, yellowish-green, lobes whitish with mauve margins, anthers included. Locality and habit-wise it is difficult to distinguish from *A. triflorus*. Tölken describes it as a high altitude species, not often collected, whereas the very similar but smaller species *A. triflorus* is found on the lower slopes.

A. maximus P.C.Hutch.: On the lower mountain slopes between Clanwilliam and Vanrhynsdorp, and reported from the top of the Gifberg in the Western Cape. This robust species is the largest *Adromischus* and is known to reach 300 mm in the veld without flowers. The leaves are oblong-spathulate, unspotted, 40-130 mm long, with horny margin in the upper half, sometimes complete, pale yellowish-green. Inflorescence 250-450 mm, with greyish bloom, flowers 1-3(-7) at each bract, the corolla tube 8-11 mm, greenish, lobes white or cream, tinged pink, anthers included. The plant has short, densely clustered flowers which distinguish it from *A. sphenophyllus* of the Eastern Cape.

A. sphenophyllus C.A.Smith: This is the commonest species in the Eastern Cape; extending from Steytlerville to East London and inland to Graaff-Reinet, mostly in karoid veld. The species looks like a smaller edition of *A. maximus*; the leaves grey-green, often red-margined, unspotted, with a prominent winged marginal ridge which continues to the leaf base which is auriculate. Inflorescence 200-450 mm high, cymes 1-2 flowered, corolla 9-12 mm long, greyish-green, with lobes rough, white to pink with mauve-coloured margin, anthers enclosed. The continuous horny leaf margin distinguishes it from *A. inamoenus*.

A. inamoenus Tölken: From Herbertsdale west of Mossel Bay to the hills around Grahamstown in the Eastern Cape. Its name means 'unlovely' or 'unassuming'. Small shrubs with decumbent branches; leaves dorsiventrally compressed, 20-30 mm long, 15-25 mm broad, with a horny margin round two-thirds of the leaf, grey-green sometimes brownish and without spots. Corolla tube 9-12 mm long, green, lobes white with marginal mauve line, trichomes mainly at the throat.

5 Section *Longipedunculati* V. Poelln.

The axis of the inflorescence more or less zig-zags, at least when young, buds distinctly grooved and pressed to the axis at first, later erect to spreading, a dense waxy bloom on flowers. Corolla tube bluish-green, with club-shaped hairs in the throat, corolla lobes lanceolate and up to three times longer than broad, white with reddish line along the margin, anthers included.

A. leucophyllus Uitewaal [colour p. 94]: on the

Langeberg Mountains between Robertson and Montagu, and on the Witteberg (Touws River to Laingsburg) in the Great Karoo. Decumbent branches up to 100 mm long, leaves oblanceolate to orbicular, 20-30 mm long, with complete horny margin, the leaves white, covered with a thick bloom. Inflorescence 200-350 mm, corolla tube 11-15 mm, white or pale pink, lobes white with a median pink band.

A. subviridis Tölken: On the Bloukrans Pass south of Calvinia, the Bokkeveld escarpment and northern Tanqua Karoo in the Western Cape. Much-branched shrublets with decumbent branches up to 250 mm long with fibrous roots; the sessile, oblanceolate, acute leaves are 30-55 mm long, pale green with or without reddish spots, with distinct horny margin right around the leaf. Corolla tube 10 mm long, green with a thick bloom, hairs present in the throat, lobes yellowish-pink. The species is distinctive and was described by Tölken from the type locality but has since been found further afield.

A. marianiae (Marloth) Berger [colour p. 95]: A variable species extending from Clanwilliam to just north of the Orange River. Extensive field work has shown a continuous range of variation and Tölken suggests that introgressive hybridization is occurring. Within this varied complex, he recognises four varieties: var. *marianiae* extends from Clanwilliam to south of Vanrhynsdorp. Low-growing, clump-forming plants, the long (about 100 mm) fairly narrow, pointed leaves are smooth-surfaced and concave above, with a horny, raised marginal ridge; roots are fibrous. Plants from Clanwilliam have spotted leaves, but elsewhere they are spotted or unmarked. The inflorescence is up to 350 mm tall, with 1(-3)-flowered cymes, the corolla tube 10-12 mm, pale pink to white with thick bloom, the lobes pink to deep red on the margins, trichomes at the throat, anthers included. Var. *immaculatus* is widely distributed in southern Namaqualand and extends to the western side of the Roggeveld Mountains. Included in its synonymy are: *Adromischus herrei*, *A. antidorcatum* and *A. alveolatus*. Small plants with tuberous roots, the leaves generally small, often canaliculate above, tapered at both ends, verrucose (warty), unspotted, the marginal ridge only slightly raised and not horny. Some of these plants are quite extraordinary in appearance and well worth cultivating. Var. *kubusensis* (*A. kubusensis*, *A. rodinii*, *A. blosianus*, *A. geyeri*); occurs on the western slopes of the coastal mountains in



Adromischus marianiae var. *marianiae*

the Richtersveld and south-western Namibia; the stems short and often becoming prostrate, the leaves somewhat convex on both surfaces to terete, with marginal ridge at the apex not horny, smooth-surfaced, pointed at tips, rarely spotted, roots fibrous. Var. *hallii* (*A. hallii*, *A. casmithianus*) grows within 30 km of the coast of the northern Richtersveld and south-western Namibia. Small plants with tuberous roots; distinct from the other varieties in having dorsiventrally compressed leaves, broadly obovate or circular, greyish-white, sometimes spotted, marginal ridge horny and usually undulate.

A. cooperi (Bak.) Berger (*A. pachylophus*, *A. festivus*, *A. halesowensis*): Widespread but uncommon between Uitenhage, Graaff-Reinet and Queenstown, on south-facing aspects which provide shade. Shrublets with short branching stems; leaves glabrous, obtuse, truncate or compressed dorsiventrally at the apex, 40-65 mm long, with markings or without, in typical *A. cooperi* the apical leaf ridge is wider than remainder of the leaf; aerial roots on stems usually absent. This is an attractive small species, about 100 mm high, the mottled, almost terete leaves ending in a truncated, undulated leaf-tip. The inflorescence 250-400 mm tall has 1-flowered cymes, corolla tube 9-11 mm, pale pink with bloom, the lobes are pink becoming deep red at margins and petal tips. Club-shaped trichomes are present in corolla throat and on lobes.

A. cristatus (Haw.) Lem.: The species is almost entirely contained in the Eastern Cape, and is at once recognised by the wavy terminal margin of the usu-

ally broad leaf-end and the dense beard of reddish-brown aerial roots on the stems. Var. *cristatus* is scattered between Port Elizabeth, Uniondale and Graaff-Reinet; the stems 20-40 mm long, covered with aerial roots, the ridge at the apex of the leaf is the broadest part of the leaf; leaves obtriangular-spathulate and petiolate, the leaf blade one to one and a half times longer than the apical ridge is broad; inflorescence and petals glabrous. The inflorescence is 100-200 mm, with 1-flowered cymes, corolla tube green, lobes white tinged pink with darker margin. Tölken described var. *zeyheri* from restricted material from near Riversdale. It differs largely from the rest in being the only variety present in the Western Cape and it lacks aerial roots; it has since been found further east in the Kougaberg and Baviaanskloof. Var. *clavifolius* (*A. clavifolius*, *A. poellnitzianus*, *A. nussbaumerianus*, *A. kesselringianus*) occurs in rocky terrain between Alexandria, Grahamstown and East London, stems 20-40 mm long, with aerial roots, the apical ridge of the leaf forming the broadest part of the leaf; leaves two to five times longer than the apical ridge is broad, glabrous, the leaves generally narrower than those of the typical variety. Var. *schönlandii* (*A. schönlandii*) occurs in protected spots in the Langkloof and Baviaanskloof west of Humansdorp; stems 20-40 mm long, with aerial roots; leaves up to 35 mm long, apical ridge of leaf narrower than broadest part of the leaf, distinct in being almost terete, sticky, and pubescent with narrow petioles; inflorescence and petals glandular-hairy.

Kalanchoe Adans.

The genus *Kalanchoe* was described in 1763 by Adanson who derived the name from the Chinese epithet for one of the species. Widespread in Asia and Africa, the genus is distinguished by its flowers which have their parts in fours, the stamens being in two whorls of four. In 1907, Raymont Hamet sunk the genera *Kitchingia* and *Brophyllum* (both of Malagasy origin) into *Kalanchoe*. *Brophyllum* is currently recognised and is distinguished by its pendulous, tubular flowers and its habit of producing miniature, bud-like plants along the leaf margin. The common *B. delagoense* (Eckl. & Zeyh.) Schinz (*B. tubiflorum*) introduced from Madagascar soon takes over an entire garden by the vegetative production of sturdy leaf buds. At least four Madagascan species have been introduced into South Africa but only *B. delagoense* has established itself in

disturbed areas and roadsides in Mpumalanga.

Kalanchoe has a complicated taxonomic history: of the approximate 230 species described, at least 100 names have been relegated to synonymy. This confusion coupled with the fact that many of the southern African species form unattractive, tall, lanky plants, often dying back completely after flowering, accounts for their brief treatment here. The greatest variety and the most decorative species occur in Madagascar – this is the homeland of the popular scarlet-flowered *K. blossfeldiana*, *K. manginii* with its red hanging bells and *K. tomentosa* which has white felty leaves edged in chocolate-brown. *Kalanchoe* is an old genus which occurs in Africa, Madagascar and tropical Asia. In South Africa it does not proceed south of the Orange River into the western and central karoid areas. Thirteen species enter eastern South Africa, Botswana and Namibia, of these only three species reach the Eastern Cape; the genus is also well represented in Zimbabwe, Angola and Mozambique.

Kalanchoe in South Africa, Namibia and Botswana (some of these species have a wider distribution)

K. rotundifolia (Haw.) Haw. (*K. decumbens*): Extremely widespread: Namibia, Botswana, Transvaal, western Free State, KwaZulu-Natal, Swaziland, Zimbabwe, Mozambique, Tanzania and Socotra. Tölken views it as the most complex species in the genus in southern Africa. It is a common red-flowered species with erect, terete stems up to 1.2 m tall; the leaves elliptic to roundish-ovate, subpetiolate. The inflorescence is sparsely round-topped, the corolla tube slender with narrow, acute lobes. Tölken describes five forms from different South African areas in which the leaves vary from entire to deeply lobed from one season to the next. In one of its rare illustrations (*Crassulaceae* 1985) 6 leaf variations are depicted.

K. laciniata (L.) DC.: This species has a single record from the central Kaokoland in Namibia, and has an extensive distribution from Angola through eastern Africa to the Arabian Peninsula and India. The erect stem reaches up to 1 m, the leaves are deeply dissected, with crenate margin and long stem-clasping petiole.

K. lanceolata (Forssk.) Pers.: Present in Namibia, Botswana, Transvaal and widely in Zimbabwe; it also extends from eastern Africa to India. The erect

stem is up to 1.5 m, the leaves are sessile, narrowly oblong or elliptic, 60-150 mm long, with a cuneate, clasping base.

K. brachyloba Welw. ex Britten: Widespread from central Namibia to Botswana, Transvaal, Swaziland and KwaZulu-Natal, also from Angola and Zimbabwe to Mozambique and Zambia. The stem is up to 2 m tall, the whitish blue-green leaves which form a rosette are 120-180 mm long, 40-80 mm across with crenate margins; the leaves are lobed except in southern Namibia where they are entire or nearly so. The inflorescence is up to 700 mm tall and flat-topped, the yellowish flowers 15 mm long.

K. thyrsiflora Harv.: Common in Mpumalanga, extending along the Drakensberg to KwaZulu-Natal, eastern Free State, Lesotho and Eastern Cape. It is the first *Kalanchoe* illustrated in *The Flowering Plants of South Africa* and a popular garden plant because of its colourful rosette of leaves. Like most of the southern African species, it forms a basal rosette of large leaves, sending up its flowering stem to a height of 1-1.3 m. The lower leaves are rounded with red margins and covered with white powdery bloom, becoming smaller and narrower as they ascend the flowering stem; the inflorescence is an oblong, close-set panicle of greenish flowers with yellow, recurved lobes.

K. crenata (Andr.) Haw. (*K. hirta*): From central KwaZulu-Natal to the Eastern Cape. The shrub has one to several erect stems to 1.5 m tall. Leaves are glabrous to hairy, petiolate, 40-110 mm long with subcrenate margins, yellow to deep green. Tölken adopts a broad view of *K. crenata* which includes the more robust hairy *K. hirta* which grows in the bushveld. The name 'hirta' meaning 'rough' refers to the short, rigid hairs which cover the whole plant. Previously, smaller plants with glabrous leaves were regarded as *K. crenata*. As hairy forms of the less robust *K. crenata* exist, the two forms have been combined for the present, and Tölken notes the importance of further field collection. The inflorescence is round-topped, the corolla yellow or orange.

K. paniculata Harv.: Extends from Mpumalanga to the Free State and northern Eastern Cape; it also occurs in Zimbabwe. Collected by Burke and Zeyher near the Vet River in the Orange Free State in 1839-1940, this is another of Harvey's early spe-

cies. According to Verdoorn, it is the commonest yellow-flowered species of *Kalanchoe* in the Transvaal, where its wide, flat-topped inflorescence makes an attractive display in the veld. The basal leaves are up to 200 mm long, 70-80 mm broad, folded upwards and falcate in outline.

K. neglecta Tölken: Uncommon on sandy soils in north-eastern KwaZulu-Natal. There is usually one erect stem up to 1 m tall from the basal rosette. Leaves are glabrous, petiolate but not clasping, ovate, 35-80 mm long, deeply cordate or peltate. Inflorescence is flat-topped, densely flowered in yellow and glabrous.

K. alticola Compton: From Barberton in Mpumalanga and Swaziland. Shrublets with flaccid, decumbent stems, rooting at the base to form large groups. Leaves sessile, oblanceolate, flat and entire, 20-45 mm, cuneate and clasping. The inflorescence is round-topped, sparsely flowered, the flowers yellow to orange.

K. longiflora Schltr. ex Wood: Endemic to central KwaZulu-Natal along the Tugela River. Shrublet to 400 mm, the leaves petiolate or with a cuneate base, leaf obovate to nearly orbicular, 40-60 mm long, greyish-green with a thick bloom. Inflorescence round-topped, with yellow to orange flowers. It can be distinguished from the related *K. sexangularis* by its grey leaves and quadrangular stems.

K. sexangularis N.E.Br. (*K. rubinea*): On the escarpment from Mpumalanga to Swaziland and north-eastern KwaZulu-Natal; also in Zimbabwe, shade-seeking. An erect or decumbent species which produces several terete, erect flowering branches to 1 m. Leaves are petiolate, glabrous, leaf blade broadly elliptic to ovate, 50-70 mm long, 40-60 mm broad, cordate to cuneate, folded length-wise, the margin dentate, green to deep red. Inflorescence flat-topped, flowers glabrous, corolla tube 7-10 mm long, yellow. This species is often cultivated.

K. crundallii Verdoorn: Endemic to the Soutpansberg in the Northern Province. Fleshy, glabrous, pruinose plants with habit similar to that of *K. thyrsiflora*; the simple stem ascending to about 900 mm tall, the opposite and decussate leaves petiolate and suborbicular, 35-70 mm long and almost the same in width. The inflorescence a short cymose panicle, the corolla coral-red or greenish-yellow when not exposed to the sunlight.

K. luciae R.-Hamet: The typical subspecies extends from the Northern Province along the escarpment into Swaziland and northern KwaZulu-Natal, also northwards into Zimbabwe. Erect to 1.5 m tall, glabrous, leaves obovate to orbicular. The inflorescence is slender, the flowers pale yellowish-green. Subsp. *montana* (*K. montana*) which grows on Entembe Mountain, Swaziland, extends from south of Lydenburg in Mpumalanga to Mbabane Swaziland. It is seldom more than 1 m tall, the fleshy stem is glandular-hairy, the leaves (up to 180 mm long) narrowly oblanceolate and rarely obovate; sepals 5-6 mm long and hairy.

Zimbabwe

The following eight species are listed for Zimbabwe (Percy-Lancaster & Richards in *Provisional Checklist, Excelsa* 15:1991): *K. brachyloba*, *K. laciniata*, *K. lanceolata*, *K. luciae* subsp. *luciae*, *K. paniculata*, *K. rotundifolia*, and *K. sexangularis*, all of which are described under South African species, and *K. velutina* subsp. *chimanimaniensis* which is entered under Angolan species.

Angola

K. salazari R.-Hamet: Angola: Humpata, Huila Province. Slender, erect, glabrous stems, leaves sessile, acute, 22-33 mm long, 8-10 mm broad, margins entire. Inflorescence a many-flowered panicle, corolla suburceolate and the tube 6-7 mm long. Close to *K. brachyloba* and *K. lindmanii* but distinguished by its very small flowers.

K. exellii R.-Hamet: Angola: among rocks at 1000 m near Capir in Cuanza Sul. Allied to *K. scapigera*. The stem is rhizome-like, short, simple or divided, glabrous or rarely hairy, the leaves narrow with sinuate margins. Inflorescence slender, corolla urn-shaped, about 13 mm long.

K. scapigera Welw.: Angola. Stout glabrous stems to 400 mm tall, leaves sessile, obovate, margins entire, waxy pruinose; flowers brilliant red.

K. platysepala Welw.: Angola. Described by Welwitsch from material from the mountains of the Huila Province. Stems hairy, leaves linear, about 3 mm across, margins entire or sinuate. Flowers small, corolla tube 7-8 mm long.

K. humbertii Guill.: Angola. Roots tuberous, stems erect with sessile leaves, spatulate, 60-70 mm long, rounded. Flowers yellow, corolla 20 mm long.

K. lindmanii R.-Hamet: Angola: Humpata, Huila Province. About 500 mm tall, leaves sessile, opposite and decussate, 25-120 mm long. Corolla tube 11-13 mm long and suburceolate.

K. velutina Welw.: Angola and East Africa. Thick, fleshy rhizome; the whole plant is hairy, lower leaves ovate, 110 mm long with amplexicaul petiole and up to 80 mm across, upper leaves narrower. Flowers yellow, 12 mm long. Subsp. *chimanimaniensis* describes plants which occur on mountains of that name in eastern Zimbabwe.

Mozambique

K. hametorum R.-Hamet: Mozambique: Nampula. An unusual *kalanchoe* with erect, hairy stem bearing a few salmon-coloured flowers and is probably an annual. Leaves hairy and narrowly linear 65-85 mm long, 4-5 mm broad. Corolla tube about 13 mm long.

K. humilis Britten: Mozambique: Zambesi region. An attractive small glabrous species, slender stem 80-100 mm tall, leaves about 20 mm long, 8 mm across, quite grey in the dried state, and sparingly toothed. Inflorescence a dichasium, few-flowered.

K. mocambicana Res. & Sobrino: Mozambique. Flowering stems up to 2 m tall, leaves 90-150 mm long, 50-80 mm across, petiolate, dentate-crenate. Inflorescence forked with many greenish-yellow flowers.

K. fernandesii R.-Hamet: Mozambique. Robust, glandular-hairy erect stems; leaves sessile, ovate, margins crenate near apex; inflorescence paniculate and many-flowered.

K. figueiredoi Croiz.: Mozambique. Creeping plants with fleshy taproots, erect stem 150-200 mm, leaves in whorls, obovate, 30-60 mm long, 15-30 mm across, purple-spotted, margins crenate near the tip. Inflorescence forking, the flowers green with pinkish lobes.

K. latisepala N.E.Br.: Mozambique. Leafy erect stems, the leaves ovate with crenate margins. The

inflorescence a head of long flowers with broad sepals, the corolla tube 30 mm long, distinguishing the species from the allied *K. schimperana* which occurs in north Africa, in which the corolla tube is 40-60 mm long.

Crassula L.

The genus *Crassula* of southern Africa presents a large diversified group of plants adapted to a wide range of habitats from cool shade to dry exposure. Their main distribution is from the eastern escarpment of South Africa round to the south-western Cape and northwards into southern Namibia. Their taxonomy, like that of most succulents, is problematical and much work on this was carried out between 1687 and 1929, in which latter year Schönland published a re-evaluation of the genus with 223 species. The following list of species with descriptive comments in proportion to their interest, is adapted from *A revision of the genus Crassula in Southern Africa* (1977) by H.R. Tölken. The new combinations at varietal level by G.D. Rowley are incorporated (*Cact. & Succ. J. (UK)* 40(53), 1978). In Tölken's revision of *Crassula*, the genus is divided into 20 sections, 149 species and numerous subspecific taxa. In Tölken's 1977 revision he divided the genus into two subgenera, subgen. *Disporocarpa* for sections 1-9 and subgen. *Crassula* for sections 10-20; in his later work, *Crassulaceae (Flora of Southern Africa* 14, 1985) this division was not used. The small herbaceous annual species have been omitted in the account which follows.

A broad range of criteria were used in the new arrangement, including seedling morphology and the distribution of hydathodes on the leaves. The latter are water-secreting elements and are used for this purpose by the soft herbaceous and annual species, but Tölken shows that the hydathodes in most species actively absorb water, resulting in the quick recovery of desiccated tissue. Hydathodes are not present in other genera of *Crassulaceae* in southern Africa.

The flowers of *Crassula* are small, and congested into white, pink or, less often, scarlet heads. It is generally the leaf form and not the flowers which attract the collector.

1 Section *Helophytum* (Eckl. & Zeyh.) Tölken

Annual or perennial, erect or decumbent, herba-

ceous, glabrous, often with rhizomes, 4-merous flowers develop in the axils of the opposite leaves. Widespread in Southern Africa.

Only perennial species are given here.

C. gemmifera Friedrich: Previously included under the annual, *C. vaillantii*. Widespread in the eastern Drakensberg Mountains in northern KwaZulu-Natal, Lesotho and northern Eastern Cape, in moist shade. Erect or decumbent up to 70 mm, rooting at nodes along the stem, leaves linear, 3-5 mm long, fleshy. Flowers 4-merous, the corolla cup-shaped, white.

C. inanis Thunb.: On the foothills of the Drakensberg in eastern South Africa, and as far west as Knysna, in places with standing water. The underground rhizome produces soft branches up to 300 mm long which trail along banks of small rivers. The leaves are flattened, lanceolate, 10-20 mm long, flowers white.

C. tuberella Tölken: Present only along the Mpumalanga and KwaZulu-Natal border. The rhizome produces several erect stems up to 150 mm long, leaves linear, 5-15 mm long, fleshy. Flowers are 4-merous, corolla cup-shaped, white.

2 Section *Glomeratae* Haw.

Delicate annuals or small perennials with sessile axillary inflorescences at the upper end of the stem. Flowers usually star-shaped with acute sepals which are as long or longer than the petals; anthers less than 0.3 mm long. Widespread in southern Africa but also elsewhere in Africa, as well as India and Australasia.

One annual of commemorative interest and two perennials are given here.

C. pageae Tölken: In shallow depressions or on southern aspects often in the shade of Karoo shrubs: western karoo to Calvinia. This diminutive annual has a condensed stem and is flattened into a disc not more than 20 mm across. It was described by Schönland in 1923 under the name of *Pagella archeri*, in honour of Mary M. Page, who discovered it and who is remembered today for more than 300 exquisite drawings and paintings of Cape species which she completed while at the Bolus Herbarium, University of Cape Town. Her name is commemorated by Tölken in his re-naming of this

tiny crassula. The corolla is cup-shaped, brown to red.

C. lanceolata (Eckl. & Zeyh.) Endl. ex Walp.: Perennials with decumbent stems 50-150 mm long, the stems and upper root having peeling bark, leaves glabrous, sessile, lanceolate, 5-12 mm long. Flowers 5-merous, corolla cup-shaped, pale yellow, becoming brown. Subsp. *lanceolata* (*C. schimperi*) occurs in central and eastern Transvaal, along the eastern sector to southern and south-western Cape. It is distinguished by its leaves being more or less acute, but not awned, whereas the other two subspecies have leaves with terminal awns. Subsp. *transvaalensis* is widespread in Namibia, Transvaal, KwaZulu-Natal, Zimbabwe and Angola on open savannah or grassland; it is stiffly erect and has a tuberous carrot-like root. Subsp. *denticulata* is erect to spreading and takes up exposed positions on the top of rocks in northern Transvaal and Malawi, and probably occurs in Zimbabwe; its decumbent stems produce short branches which break off and become separate plants, the leaves have denticulate margins.

C. muscosa L.: Subshrubs 100-400 mm tall; erect or decumbent, the slender branching stems slightly woody, densely covered by four ranks of triangular, scaly small leaves, often giving the stem a 'pipe-cleaner' appearance. Var. *muscosa* is better known as *C. lycopodioides*, now placed in synonymy; it is present in most karoo areas, Namaqualand and southern Namibia. Flowers appear on sessile dichasia in the axils of the leaves, with sessile 5-merous flowers, corolla cup-shaped, pale yellow-green to brown. Var. *polypodacea* is a sinuous or decumbent form with branches 300-500 mm long, the yellowish-green leaves adpressed to the stem; found in the area enclosed by Willowmore, Port Elizabeth and King William's Town. The remaining two varieties are both small plants with tufted habit 100-150 mm high: var. *obtusifolia* has woody branches and extends from Cedarberg to the Orange River; var. *parvula* occurs in dry vegetation in mountains between Uniondale, Grahamstown and Middelburg in the Eastern Cape. This last variety is on the checklist of Zimbabwe succulents (Percy-Lancaster & Richards 1991), but this record seems unlikely as it would be separated by a vast distance from the Eastern Cape form; it is more likely to belong to the widespread var. *muscosa*, which is in itself, a variable form. Also, var. *parvula* is very similar to the typical *C. lanceolata*, with some differences in the nature of their stems.

3 Section **Dinacria** (Harv.) Schön.

The species in this section are all annuals, two of which have unusual bright yellow flowers.

4 Section **Filipedes** (Harv.) Schön.

Decumbent or prostrate perennials with mostly herbaceous stems; single, 5-merous, star-like flowers in the axils of the leaves. Widespread in southern Africa, tropical Africa and Madagascar.

C. papillosa Schön. & Bak.f.: Dense cushion-like plants up to 200 mm across; often at high altitudes in deep shade from Queenstown to the mountains of south-western Cape.

C. expansa Dryand. [colour p. 95]: The typical subspecies is widely spread from dry regions of Namaqualand to coastal forest in KwaZulu-Natal; branches are decumbent with glabrous leaves and no 'stilt' roots. Subsp. *filicaulis* is slightly woody with glabrous leaves and develops 'stilt' roots; it grows on coastal dunes from Port Alfred in the eastern Cape to the Cape Peninsula. In subsp. *pyrifolia* the glabrous leaves have hydathodes scattered over the entire surface, flowers are borne in terminal clusters; found on sand in the coastal belt from Namaqualand to south-western Namibia. Subsp. *fragilis* occurs on rocky slopes or open savanna from northern KwaZulu-Natal through Swaziland and Transvaal into tropical Africa. Its leaves are hairy or glabrous, with hydathodes scattered on the upper surface. **C. peculiaris** (*C. expansa* subsp. *peculiaris*): Only from the Swartberg Pass north of Oudtshoorn in the Western Cape, at an altitude of 1500 m. Similar to *C. expansa* but differing in habit and locality and in its papillose seeds. The thin prostrate stems up to 300 mm form a mat, leaves petiolate, ovate to elliptic, 3-8 mm long, hirsute. Corolla is cup-shaped, white.

C. tenuicaulis Schön.: In shade, recorded from northern Drakensberg in KwaZulu-Natal and Lesotho, also from north-eastern Zimbabwe. Slender stems up to 350 mm long often form a dense mat, with roots at the nodes.

5 Section **Deltoideae** DC.

Erect, decumbent or prostrate perennials with gla-

brous, herbaceous, succulent or slightly woody stems. Angular-obovate or oblanceolate leaves covered with flakes of wax (except in the case of *C. elsiae*). Flowers are tubular, generally with a swollen base. Widespread in central South Africa.

C. elsiae Tölken: Only known in shaded rocky habitats in the northern Cedarberg. A small species with decumbent or prostrate branches up to 100 mm long, the green leaves non-waxy, persistent and up to 4 mm long; the corolla not bulging at the base. Its name honours its discoverer, Elsie Esterhuysen.

C. corallina Thunb. [colour p. 95]: Prostrate or decumbent, with branches up to 80 mm long; subsp. *corallina* has fibrous roots, leaves angular-obovate, 3-5 mm long; it is widely distributed from the Free State and Eastern Cape to the Richtersveld and south-western Namibia. Subsp. *macrorrhiza* has tuberous roots, prostrate stems usually without adventitious roots; it grows on bare patches of sand in Bushmanland and south-eastern Namibia.

C. vestita Thunb.: Small rare perennial found under shrubs in the southern Roggeveld Mountains in the south-western Cape. Erect and spreading to 80 mm, the branches are column-like, densely covered by leaves, which have flaking wax and are adpressed to the stem. Flowers in dense terminal dichasia, corolla urceolate, cream.

C. deltoidea Thunb. [colour p. 95]: Has a wide distribution from the southern Karoo through Bushmanland to south-eastern Namibia. A distinct species about 60 mm tall with fleshy short branches and very fleshy, white, mealy-coated, triangular leaves deciduous when old. When flowering, it is distinguished from others in its section by its inflorescence being separated from the leaves by a definite peduncle.

6 Section *Anacampseroideae* Haw.

Prostrate to erect perennials (rarely annual) with herbaceous, succulent to slightly woody stems, usually glabrous. Leaves commonly flat, glabrous, hydatodes in dense rows and marginal; petals 2-8 mm long, spreading from the base to form a star-shaped flower in which each petal has a sharp terminal appendage and the slender styles arise from the posterior ovary apex. Common in the Eastern

Cape and KwaZulu-Natal, also extending to the south-western Cape.

C. pellucida L.: Subsp. *pellucida* has decumbent, glabrous branches, up to 600 mm long, rarely rooted at the nodes, found in rocky outcrops in shade from the Swartberg Mountains to the Cape Peninsula and northwards to the Cedarberg. The opposite leaf pairs are distant from each other, lanceolate, petiolate, 10-25 mm long, flattened, green with white or red margin. The inflorescence is terminal with star-shaped pinkish flowers. Subsp. *spongiosa* is an annual, decumbent and rooting at intervals, in sheltered areas from Nieuwoudtville to Calvinia. The calyx and receptacle become spongy on maturity, apparently delaying seed dispersal. Subsp. *marginalis* is a prostrate perennial growing in rocky outcrops in moist places along the coast from George to East London in the Eastern Cape. It varies from being glabrous with broadly ovate leaves in the west to having lanceolate leaves with hairs on the leaf sheath margins in the East London area. Subsp. *brachypetala* is one of the most widespread of the *Crassula* complex and is distinguished from others in its section by its hairy stems and pedicels; it extends from the Eastern Cape through KwaZulu-Natal and the Transvaal into tropical Africa. Subsp. *alstonoides* is very similar to subsp. *brachypetala*, but distinct from it in possessing a serrulate leaf margin and is associated with damp forest conditions from Knysna to Natal, eastern Transvaal, Zimbabwe and other parts of tropical Africa.

C. inandensis Schönl. & Bak.f.: Associated with forests from northern Transkei to Eshowe in KwaZulu-Natal; branches scrambling, up to 600 mm long; sepals very swollen at the apices and the paired leaves just below the elongate inflorescence are larger than the rest. The inflorescence is round-topped, peduncle 10-30 mm, sometimes hidden by the leaves, corolla star-shaped, cream, lobes linear. Flowering in November.

C. spathulata Thunb.: In forest areas between Knysna and the Transkei. A rooting prostrate with stems often quadrangular, leaves petiolate, ovate, 20-25 mm long with a serrate margin. Inflorescence a dichasium with peduncles 30-70 mm, very small flowers at right angles to the axis, corolla star-shaped, white tinged red.

C. sarmentosa Harv.: Produces tubers at the base of metre-long stems which do not die down after

flowering; hanging or trailing on rock faces in ravines. Subsp. *sarmentosa* occurs in the coastal area of central KwaZulu-Natal, and separately near Knysna where it may be a garden escape. Leaves elliptic or ovate, up to 15 mm long. The inflorescence is round- to flat-topped with the flowers spreading at right angles to each other. The corolla is star-shaped, white or cream, flowering in August. Subsp. *integrifolia* which also grows in KwaZulu-Natal is distinguished by its entire leaf margin and almost erect flowers.

C. crenulata Thunb.: In shade along the coast from Mossel Bay to central KwaZulu-Natal. Geophytic, the underground tubers producing one unbranching stem annually, up to 400 mm high when in flower. Distinguished from *C. spathulata* and *C. sarmentosa* by sessile leaves four times as long as broad. Inflorescence terminal and flat-topped, the corolla is star-shaped, white or cream, tinged pink, stamens with purple anthers. Flowering January to April.

C. streyi Tölken [colour p. 95]: Branches decumbent up to 300 mm long on steep rocky cliffs in the Port Edward area of KwaZulu-Natal. The beautiful, sessile broad leaves have a short apical point, are dark green with white spots on the upper surface and maroon below. Hydathodes are conspicuous in a double row along the leaf margin, this distinguishing the species from the closely allied *C. multicava*, which has hydathodes scattered over both leaf surfaces. The inflorescence is delicate, the greenish-white 4- to 5-merous flowers spreading at right angles to each other and appearing May to June.

C. multicava Lem.: Distinguished from *C. streyi* and *C. sarmentosa* var. *integrifolia* by the hydathodes being marginal and scattered over both leaf surfaces. Subsp. *multicava* is the more delicate form from the Eastern Cape. It has pinkish-white, 4-merous flowers and produces vegetative buds in the axils of the bracts on the inflorescence. The more robust subsp. *floribunda* is stiffly erect, glabrous to hairy with pentamerous flowers, no vegetative buds and grows in the coastal mountains of central KwaZulu-Natal.

C. cordata Thunb.: In shaded areas from the Eastern Cape to near Port Shepstone in KwaZulu-Natal. Erect or decumbent up to 300 mm, stems rather woody with grey-green, cordate leaves covered with hydathodes on the upper surface, petiolate, broadly

ovate, flattened, often red-spotted with red margin. Inflorescence round-topped, peduncle 30-150 mm, often umbel-like, also producing adventitious buds in the axils of the bracts instead of flowers. Corolla star-shaped, cream to pale yellow, flowering July to October.

C. lactea Soland.: Sporadic along the coast from Mossel Bay to East London. Decumbent branches up to 400 mm long. The species is distinguished by the fleshy leaves (30-50 mm long) with a single row of hydathodes along the margin which is entire but horny. Inflorescence elongated with many dichasia, peduncle 40-100 mm, corolla star-shaped, white or cream to pink at petal tips. Flowering May to July.

C. ovata (Mill.) Druce: First described as *Cotyledon ovata* by Miller in 1768; both *Crassula argentea* and *C. portulacea* are synonyms of this species. Fairly common in the Eastern Cape from Willowmore to East London and northwards to Queenstown, also in KwaZulu-Natal. A shrub 1-1.5 m tall, with stems up to 200 mm thick, much branched and old leaves deciduous. In spite of its name, *C. ovata* usually has elliptic leaves which are shiny-green, with or without a red margin. The inflorescence is round-topped, with numerous flowers, corolla star-shaped, white tinged pink, flowering June to August. Its companion species in the Western Cape is *C. arborescens* which flowers from October to January.

C. arborescens (Mill.) Willd.: Common in the mountains from Worcester to Prince Albert in the Western Cape. A large branching shrub from 1-2 m tall, old leaves deciduous. Distinguished from *C. ovata* by its broadly ovate leaves which have a grey bloom and the triangular bracts on the peduncle. Both of these large shrubs are beautiful in flower, the flowers held in terminal dense clusters, both species root readily from cuttings. In subsp. *arborescens* the leaves are obovate and 20-30 mm broad, flattened and covered with a grey bloom, margin purplish. Subsp. *undulatifolia* has elliptic, undulate, erect leaves and grows on the southern parts of the Klein Winterhoek Mountains in the Eastern Cape.

7 Section **Petrogeton** (Eckl. & Zeyh.) Walp.

A perennial, underground, almost round tuber pro-

duces annual, herbaceous, erect branches to 200 mm. The leaves are scarcely fleshy, broad, flat, with marginal hydathodes. Petals spread from the base to form a star-shaped flower (rarely tubular). Main distribution in the south-western Cape, also in the Eastern Cape and Drakensberg Mountains.

C. umbella Jacq.: In shade from Namaqualand through the south-western karoo and along the Langkloof to Humansdorp. Erect and unbranched stem 60-150 mm tall, the leaves joined into a hardly fleshy circular disc around the stem, the margins entire, crenate or double-crenate in this variable species. Inflorescence elongated, the peduncle 5-60 mm, corolla star-shaped, cream to yellowish-green. In the Worcester-Montagu succulent-karoo the slightly larger flowers are cup-shaped and tend to turn downwards.

C. simulans Schönl. [colour p. 95]: In shade in Montagu and Robertson districts. The tuber, not more than 10 mm in diameter, produces an erect stem up to 150 mm, with 2-3 pairs of green leaves with crenate margins. The peduncle is 20-60 mm long, corolla star-shaped, pale yellowish-green.

C. nemorosa (Eckl. & Zeyh.) Endl. ex Walp.: In shade on southern aspects in the Eastern Cape, but also scattered on mountains of the southern Karoo and Cedarberg. Varies from 20 mm high, erect with a few leaves, to 150 mm high with decumbent branches. Leaves are fleshy, glaucous, broadly ovate 3-15 mm long. Inflorescence loose, with 5-merous flowers without a peduncle, the corolla varies from star-shaped to cup-shaped, yellowish-green with brown stripes.

C. dentata Thunb.: In deep shade from north of Worcester to near Vanrhynsdorp. Decumbent, spreading, branching habit with the lower leaves in whorls of four, the leaf blade is ovate, set on a long petiole 6-60 mm long. Inflorescence terminal with many 5-merous flowers, corolla star-shaped, white, flowering from September.

C. capensis (L.) Baill.: Western Cape. Perennials erect from 50-150 mm tall, usually with a rhizome and several small tubers. In var. *capensis* the two pairs of broad, scarcely fleshy leaves with crenate margins are close to the ground, the open, star-shaped flowers are borne in a terminal umbel, the peduncle 20-70 mm long with 5- to 7-merous flowers; it occurs near the coast from Clanwilliam to

Caledon. It is stimulated by veld fires resulting in larger flowers. Var. *albertinae* extends from Caledon to Riversdale; it develops leaves at soil level after flowering, the peduncle is 30-100 mm long. Var. *promontorii* develops leaves before flowering, the leaves borne up to 50 mm above ground level, the inflorescence lacks an unbranched peduncle; occurs in shade on the western side of Table Mountain and Hout Bay Mountains.

C. saxifraga Harv.: Very widespread from Namaqualand to the Eastern Cape. Stem erect from 50-150 mm, unbranched with one or two pairs of leaves. The rhizome has several tubers, 30-90 mm in diam. in dry areas but much smaller in the coastal areas. The leaves develop after flowering, on the mountains sometimes with the flowers which appear from April to June. The inflorescence is umbellate on a long peduncle, the white corolla tubular: this character distinguishes it from the similar *C. capensis* which has a star-shaped corolla with lanceolate, free petals.

C. alcornis Schönl.: Known only from its type collection from Kardouw Pass, Namaqualand. Erect 60-120 mm. high, unbranched. Also with tubular flowers, but the sessile leaves are uniquely palmately lobed, the lobes repeatedly divided, scarcely fleshy.

C. umbraticola N.E.Br.: In shade, in the Drakensberg Mountains in KwaZulu-Natal, eastern Free State and the north-eastern Cape. Erect, unbranching stems 60-120 mm high with three pairs of scarcely fleshy leaves; the leaf lamina obovate or elliptic, 20-35 mm long, petiolate. Inflorescence loosely branched, the peduncle 20-30 mm, flowers 5-merous, spreading on long pedicels, corolla star-shaped, white.

8 Section *Galpiniflora* Tölken

Prostrate perennial with fleshy branches ending in a rosette of leaves; the star-shaped flowers on annual branches produced from below the rosette. (Only one species).

C. peploides Harv. [colour p. 95]: On damp shallow soil on rock surfaces at high altitudes above 2000 m in the Drakensberg from southern Mpumalanga, KwaZulu-Natal to the northern Eastern Cape. Terminal rosettes of linear-triangular leaves on fleshy stems. Inflorescence of several dichasia, pe-

duncle very short, corolla star-shaped, white tinged red.

9 Section *Acutifolia* (Schönl.) Tölken

Erect to decumbent shrubs with fleshy to slightly woody stems often papillate when young. Sessile and usually awl-shaped leaves have widely-spaced hydathodes on the margin and a membranous sheath between the leaf bases. The petals are ridged without appendages and form a tube. Widely distributed throughout South Africa and extending into south-east tropical Africa.

C. ericoides Haw. [colour p. 95]: In the coastal belt from south-western Cape to KwaZulu-Natal. Usually erect from 150-300 mm high, with short, flat leaves and a sessile, capitate inflorescence of white tubular flowers, the petal tips erect and acute. Subsp. *ericoides* is an erect plant of grassveld and coastal habitat from Bredasdorp (Cape) to Eshowe in KwaZulu-Natal. The short leaves 3-7 × 1-3 mm are densely arranged in four opposite ranks up the stem, rather like an *Erica*. Subsp. *tortuosa* is a prostrate form found at high altitudes in the mountains of the Little Karoo.

C. dependens H.Bolus: Widespread in eastern South Africa with an outlier in the Auas Mountains in Namibia. Variable with a large synonymy. Thin, wiry or succulent decumbent stems up to 200 mm long, covered with hair-like papillae. Leaves linear-lanceolate, 5-15 × 1-2 mm, acute, glabrous. The inflorescence is nearly flat-topped, with few to many flowers, lacking a distinct peduncle. Corolla tubular, white, flowering in December.

C. sarcocaulis Eckl. & Zeyh.: An entirely eastern distribution from the Northern Province and Mpumalanga to the north-eastern Eastern Cape. Erect or spreading shrubs 200-400 mm high, young branches with hair-like papillae and bark peeling when older. Subsp. *sarcocaulis* has elliptic leaves and short sepals, the flowers with an unpleasant scent, corolla tubular, white. Subsp. *rupicola* is a densely branched shrub with very fleshy stems and linear-lanceolate leaves 8-20 mm long, at times almost terete; it occurs throughout the Drakensberg Mountains. It flowers from January to April, whereas subsp. *sarcocaulis* flowers from April to June.

C. biplanata Haw.: It occurs on the mountains in

the southern coastal belt from Caledon to Humansdorp and on the Swartberg. A variable, much-branched species erect to decumbent from 150-200 mm tall, sessile leaves lanceolate, dark green but often greyish with a thick bloom. The inflorescence a flat-topped dichasium on a distinct peduncle 50-150 mm long, with many congested flowers, corolla tubular, white. Characterised by its long petals (4-5 mm) and papillae at the stem internodes.

C. planifolia Schönl.: In the Eastern Cape between Umtata and Kentani. More or less erect to 300 mm, with few fleshy branches, bark peeling. Leaves are narrow, elliptic to lanceolate, 20-35 mm long, dark green and acute, deciduous. The inflorescence round-topped and irregular, with many flowers, corolla tubular, white. Flowering from July to August.

C. tetragona L.: This well known Linnean species is widely distributed from the Orange River boundary of Namaqualand to beyond the Kei River in the Eastern Cape. It takes 16 names into synonymy, but has five subspecies to take up its variation. Erect to decumbent branched shrubs up to 1 m high, the leaves concentrated in four ranks at the upper ends of the branches, the deciduous leaves leaving glabrous jointed stems with brown peeling bark. The narrow, sessile leaves are sharply pointed, 10-30 mm long, dorsiventrally flattened to terete, with a short leaf sheath. Inflorescence terminal, peduncle 10-150 mm long, with 1-3 pairs of sterile bracts. The corolla is tubular, cream. Subsp. *tetragona* occurs in dry fynbos or renosterbos vegetation in the south-western Cape mountains, radiating northwards and eastwards. It is repeatedly branched, with flattish leaves and distinct leaf sheaths (1-2 mm long); the inflorescence is flat-topped with flowers densely clustered. Subsp. *rudis*, widespread in Namaqualand, is very similar, but has fleshy roots, is sparingly branched, and the inflorescence is irregularly branched. Subsp. *acutifolia* is prostrate and roots at the nodes: it occurs from Riversdale to King William's Town. The following three subspecies have 0-1 pairs of sterile bracts on the peduncle: subsp. *robusta* of the Eastern Cape river valleys has thick fleshy stems, the leaves blunt, upward-curving and longer than 20 mm. Subsp. *lignescens* is erect up to 800 mm tall, with wiry, woody branches and very short leaf sheaths: from Montagu (Little Karoo) to Grahamstown and also in Namaqualand. In subsp. *connivens* the stems are papillose when young, becoming thick, fleshy or woody when old; the plants erect from 200-400

mm (1 m in old examples); the inflorescence is round-topped, almost sessile and usually without bracts; on dry northern aspects of hills in the Little and Great Karoo.

10 Section *Squamulosae* Haw.

Shrubby perennials with hairs on the stem internodes, leaves linear-lanceolate, glabrous or with tough trichomes, marginal cilia well developed. Hydathodes in two dense marginal rows. Corolla tubular, lobes with appendage.

C. pallens Schönl. & Bak.f.: A coastal species from Bitterfontein in Namaqualand to southern Namibia. Much-branched shrublet up to 500 mm tall, white smooth bark, old leaves deciduous. Leaves lanceolate, 10-20 mm long, glaucous. Leaves and sepals are glabrous. Aerial branches produce long stiff adventitious roots which absorb surface moisture. Inflorescence with several dichasia, each with densely clustered nearly sessile tubular white flowers, becoming brown.

C. rudolfii Schönl. & Bak.f.: On western slopes of mountains from Bitterfontein to the Orange River in Namaqualand, keeping to the higher levels. Much-branched erect or scrambling shrub to 800 mm high, with rough stringy bark, old leaves deciduous. Lanceolate leaves up to 15 mm long, somewhat fleshy with ciliate margins; sepals papillate and hairy. Distinguished from *C. pallens* by its ciliate leaves and sepals.

C. whiteheadii Harv.: From Bitterfontein to the Orange River in Namaqualand, on the lower slopes. Small shrublets under 150 mm in height, much-branched with a fleshy tuber; bark flaking on old stems, old leaves deciduous, stilt roots present. Narrow leaves (3-5 mm long) have marginal hairs when young, acute. Inflorescence of one to several cymose clusters of white, tinged red, flowers, corolla tubular to urn-shaped. Distinguished from the similar *C. muricata* by the dorsal appendage on the petal, and cilia on leaves and sepals.

C. muricata Thunb.: On mountains in northern Little Karoo and Ceres Karoo. Much-branched shrublet up to 250 mm high, stems covered with adpressed hairs when young, the bark peeling in the older stems. Similar to *C. whiteheadii* and also producing a tuber. Distinguished from the latter by the

absence of cilia on sepals, and the petals (4 mm long) have blunt fleshy ends without a dorsal appendage. Corolla urn-shaped, white to pale yellow.

C. scabra L.: Found on low slopes from Cape Peninsula to Clanwilliam in the south-western Cape. A robust species 200-400 mm high, with few branches from the base, leaves erect and acute, especially pointed on drying from the apex, densely covered with adpressed hairs, the older leaves (20-35 mm long) recurving. Corolla tubular, white, stamens with brown anthers. Tölken records that in some areas, such as at the foot of Table Mountain, the presence of hybrids makes it difficult to delimit this species and the following two species.

C. pustulata Tölken: From the Bokkeveld to the Gifberg mountains in the south-western Cape, in pockets of sand on sandstone. Shrubby up to 200 mm tall; leaves narrow, 5-14 mm long almost terete and densely hairy, grey-green. Similar to *C. pruinosa* but petals are longer (7-8 mm), the awn-shaped sepals almost glabrous. Corolla tubular, white, the lobes with a prominent appendage.

C. pruinosa L.: At higher altitudes from the Cape Peninsula to Paarl and Stellenbosch in the south-western Cape. Shrubby up to 200 mm high, erect or spreading, leaves densely hairy, grey-green to brownish, 4-12 mm long, almost terete. The triangular sepals are 3-4 mm long and covered with adpressed hairs. Distinguished from *C. pustulata* by its dense hairiness.

11 Section *Subulares* Haw. ex DC.

Shrubs with woody stems often covered with recurved hairs. Leaves mainly linear to oblong, usually glabrous except for the margins, and generally bent to one side of the stem. The short, oblong petals (2-4 mm long) form a tube with apices recoiled, dorsal appendages indistinct. Widespread from Port Elizabeth to south-western Cape and northwards to Gifberg.

C. multiflora Schönl. & Bak.f.: Langeberg Mountains from Worcester to near Riversdale in the Western Cape. Shrubs to 800 mm high, a few branches from the base divide near the apex. In subsp. *multiflora* the narrow, flattish, scarcely fleshy, oblong leaves are 25-60 mm long. Subsp. *leucantha* is only known from Houwhoek in the vi-

cinity of Bot River and has leaves 15-25 mm long, its corolla lobes narrowly elliptic.

C. cymosa (*Crassula arenicola*): At low altitudes from the Cape Peninsula to Vanrhynsdorp in the Western Cape. Up to 350 mm tall in flower, branching at the base with main branches decumbent. Narrow, linear leaves 15-25 mm long with marginal cilia, grey- to yellowish-green. Corolla shortly tubular, joined to form a tube about 1 mm long with apices recurved and bluntly acute; yellow or cream, flowering in November.

C. lasiantha Drege ex Harv.: In shade on Groot Winterhoek and southern Cedarberg Mountains in the Western Cape. A prostrate species with wiry, very narrow stems, rooting, with old leaves attached for some time; the green, flattened, almost membranous leaves are obovate. The sepals have marginal cilia, the corolla is scarcely fused at the base, white or cream, lobes with dorsal appendage.

C. ciliata L.: In low-lying areas from Port Elizabeth through the Langkloof to south-western Cape. Shrublet with many short, decumbent, glabrous branches, about 200 mm high; leaves oblong, margins ciliate, 15-30 mm long. Many flowers with more or less distinct peduncle, the sepals with ciliate margins, corolla tubular, cream to pale yellow, lobes with indistinct appendage and remain stiffly erect for some time, later recurving.

C. subulata L.: Widespread from Vanrhynsdorp in the west to Port Elizabeth in the east, following the mountain chains. Sparsely-branched shrublets 200-400 mm high, old leaves persistent. Leaves awl-shaped, 5-20 × 1-2 mm with acute apices, grey-green to brown. In var. *subulata* the narrow internodes have two lines of hairs descending from the fused leaf bases, leaves glabrous with a few cilia. In var. *hispida* (known only from Montagu Bath) both stems and leaves are hairy. In var. *fastigiata* the branches are 2-4 mm thick, covered with recurved hairs; it occurs on sand dunes from Riversdale to Humansdorp.

12 Section *Curtogyne* (Haw.) Tölken

Shrubby to decumbent with woody stems, leaves dorsiventrally compressed, glabrous except for marginal hairs; corolla tubular, petals 5-9 mm long with dorsal appendages.

C. flava L.: From Tulbagh and the Cape Peninsula to Bredasdorp in the south-western Cape. Erect up to 400 mm when flowering, with one to several branches, glabrous or scabrid, leaves lanceolate-triangular, 20-35 mm long, scarcely fleshy; old leaves curl up and wear off slowly. Plants near Bredasdorp produce yellow flowers, which are white or cream in other areas. Flowering from December to January.

C. rubricaulis Eckl. & Zeyh.: On coastal mountains from Knysna to Port Elizabeth in the Eastern Cape. Shrublet with brown or reddish smooth stems up to 300 mm high, the glabrous leaves are 15-25 mm long, 5-10 mm broad, somewhat fleshy with marginal cilia disappearing at the leaf-ends. Inflorescence round-topped with few to many dichasia, peduncle indistinct, corolla tubular, white, tinged red, the petals oblong-ovate with dorsal appendage.

C. dejecta Jacq.: From south-western Cape mountains to near Springbok in northern Namaqualand. Dense shrubs to 400 mm high, with harsh hairs on the internodes, becoming glabrous later. Slightly fleshy, flattened, oblong-elliptic leaves 8-15 mm long with rounded marginal papillae. The species has quite a large synonymy, indicating variation: in the north the leaves are narrower, 3-5 mm broad, south of the Winterhoek Mountains they become broader, 8-10 mm; in the Olifant's River valley the leaves are ovate. Corolla tubular, white, tinged red, the petals 6-8 mm, with dorsal appendage.

C. fallax Friedrich: On sand in low-lying areas from Bredasdorp to Cape Peninsula and north to the Koue Bokkeveld and Clanwilliam in the south-western Cape. Shrubby with decumbent habit up to 400 mm long, the base of the branches covered with long leaves (30-50 mm) slightly fleshy, glabrous but with dense marginal cilia, green to yellowish-green. Corolla tubular, white or cream, petals 6-8 mm long, with dorsal appendage.

13 Section *Kalosanthus* (Haw.) Tölken

Shrubby, rarely decumbent, with fleshy to woody, glabrous stems. Leaves are very flattened, scarcely fleshy, glabrous but with marginal cilia. Vegetatively similar to species in section *Curtogyne*, this group is markedly distinguished by its long tubular flowers, petals 20-60 mm long with dorsal append-

age. On mountains from Bredasdorp to the Cape Peninsula and north to Vanrhyns Pass.

C. fascicularis Lam. (*Rochea odoratissima*): From Vanrhynsdorp to Bredasdorp in the south-western Cape. Erect shrublets to 400 mm high with flat, narrow, pointed, scarcely fleshy leaves longer than 20 mm. The inflorescence is cymose-capitate, flowers sessile, corolla tubular, fused for 4-5 mm, petals 20-32 mm long, white or yellow-green, stamens with black anthers. This species although variable is recognised by the sessile flowers, by the bracts covering the base of the flower and narrow petal tips. Flowering October to November.

C. obtusa Haw. (*Rochea jasminea*): From Vanrhynsdorp to the Cape Peninsula and eastwards along the Langeberg and Swartberg mountains. Irregular shrublets up to 150 mm high, decumbent and rooting, oblong leaves less than 20 mm with rounded apices. Inflorescence a loose cyme with 1-5 pedicellate flowers, corolla tubular, petals 30-45 mm long, white tinged pink, becoming red, stamens with black anthers. Flowering November to January.

C. coccinea L. (*Rochea coccinea*, *R. versicolor*): On mountains within the cloudbelt from the Cape Peninsula to Bredasdorp. Soft shrublets up to 600 mm high, with reddish stems and slightly fleshy, pointed leaves only 1-3 times longer than broad. Inflorescence cymose-capitate, flowers usually sessile, petals 35-45 mm long with spreading lobes, scarlet red in colour; a white-flowered form occurs near Bredasdorp. Flowering December to January. Even when classified under *Rochea* this beautiful species was known as the 'scarlet crassula' and ranked among the best of the Cape Kingdom floral species.

14 Section **Rosulares** Haw.

Perennials with fleshy stems which elongate when flowering but are otherwise short in the form of a basal leaf rosette or clusters of rosettes, leaves glabrous to densely hairy. Inflorescence flat-topped to elongated or spike-like, usually the vegetative branch grading into the inflorescence. Petals usually have distinct dorsal appendages, flower tubular. Some species monocarpic (die down after flowering).

C. flanaganii Schönl. & Bak.f.: In shade on rock

faces along coastal areas from East London to Pietermaritzburg. Shrublet up to 200 mm high when in flower with slender red branches. Slightly fleshy, glabrous leaves not in distinct rosettes, elliptic-lanceolate, 40-60 mm long. Flowers small, white, tinged pink or red in flat-topped inflorescences. Flowering March to April.

C. cymbiformis Tölken: This new species was described by Tölken in his 1985 revision in *Crassulaceae (Flora of Southern Africa)*. It is known only from its type locality near Rankin's Pass in the Sandrivierberge in Northern Province (Transvaal). A shrublet up to 200 mm when flowering, with decumbent branches, with obovate-oblong leaves in four ranks, old leaves soon disappearing. Leaves 40-80 mm long, flattened, broad-based, glabrous but with marginal cilia, green to reddish. Inflorescence terminal, flat-topped, with rather large leaf-like bracts on the peduncle, corolla tubular, white.

C. orbicularis L. (*Crassula rosularis*) [colour p. 95]: Widespread in sheltered spots from northern KwaZulu-Natal to Worcester in the Western Cape. Forming flat dwarf rosettes a few centimetres across which often offset laterally, sometimes forming a carpet of plants a metre or more in diameter in the shade under bushes. Leaves spirally arranged, glabrous with marginal hairs. The elongate inflorescence is 50-200 mm tall, with an abrupt change from basal leaves to scale-like bracts.

C. pseudohemisphaerica Friedrich: Usually in rock shade on the southern aspect of coastal mountains from Vanrhynsdorp in Namaqualand to Lüderitz Bay in Namibia. Similar to *C. orbicularis* but not to *C. hemisphaerica*. Also rosette-forming, it is distinguished by the leaves being in four adpressed ranks, densely hairy on the margins, greenish-brown and often red-spotted. Leaves are obovate to orbicular; the inflorescence is spike-like, the peduncle distinct, the corolla tubular, pale yellow, tinged brownish-red. Another distinguishing feature is the presence of pointed papillae on the ovary.

C. montana Thunb. [colour p. 95]: Vanrhynsdorp to near Worcester, on sandstone cliffs in the mountains. A much-branched species forming a cushion of rosettes of 4-ranked leaves. Leaves broadly elliptic to ovate, 5-25 mm long. The inflorescence is typically spike-like, 10-80 mm long, while the

flowers have distinct styles up to half as long as the ovaries. In subsp. *quadrangularis* on mountains of the southern Great Karoo the leaves are obovate, 7-15 mm long, adpressed forming a flat rosette, with a flat-topped inflorescence.

C. luederitzii Schönl.: In very sheltered positions on the mountains between Witputs and Aus in southern Namibia. Few to many rosettes with leaves in four ranks, leaves glabrous with marginal cilia, green to reddish-brown, often red-spotted, 10-30 mm long. It has a distinct peduncle with a capitate inflorescence of white tubular flowers, stamens with black anthers. Previously placed under *C. capitella* subsp. *thyrsiflora*, re-collection has placed it close to *C. montana* subsp. *quadrangularis* (Tölken 1985).

C. intermedia Schönl.: Fish River scrub in the Eastern Cape. 100-150 mm tall when in flower; several to many rosettes of close-pressed 4-ranked leaves, glabrous but for the recurved marginal cilia. Allied to *C. socialis*, but larger than the latter and differs in having broad, obovate leaves and an elongate inflorescence. The leaves recurve in drought, becoming erect and cup-shaped in damp conditions and when flowering. Both species have short reflexed styles.

C. socialis Schönl.: On southern rock faces from King William's Town to Kommadagga in the Eastern Cape. Small rosettes 40-60 mm high in flower, forming a dense cushion; leaves 4-ranked, ovate or elliptic. The inflorescence is rounded, the short styles reflexed: this feature distinguishing it from the very similar *C. montana* subsp. *quadrangularis*.

C. exilis Harv.: Present in very arid regions: northern Namaqualand, Bushmanland, southern Namibia and in the eastern karoo. A dwarf succulent forming dense cushions of rosettes with spirally arranged rather narrow, acute leaves; up to 100 mm high when flowering. The species is distinguished by its fruits: mature follicles spreading at right angles to the axis. The more robust, fleshy-leaved subsp. *exilis* and subsp. *sedifolia* occur on rocky outcrops in the west near the Orange River. In the typical subspecies, the peduncle is hairy, glabrous in subsp. *sedifolia*. Subsp. *cooperi* (*Crassula cooperi*, *C. bolusii*, *C. picturata*) has an eastern distribution, forming large branching cushions under rocks in the mountains between Graaff-Reinet and Aliwal North; its leaves are broader (3-10 mm), the

form called *C. picturata* with scattered red spots, rarely fleshy, the flowering erect stem is hairy with a flat-topped inflorescence.

C. tabularis Dinter: Central Namibia, southern Free State and northern Eastern Cape. Perennial or annual, 80-250 mm high when flowering, with one to several rosettes, leaves recurved but erect when the spike-like inflorescence develops. The flowering stem is scabrid with leaf-like bracts and white flowers. Very similar to *C. exilis* subsp. *cooperi* but has broader leaves (5-15 mm) and a more northerly distribution.

C. setulosa Harv.: An eastern distribution from Zimbabwe to the northern Eastern Cape. It takes 18 names into synonymy, and has four varieties which take up its variation over an extensive area. Perennials up to 250 mm tall when flowering, forming cushions of rosettes, leaves spirally arranged or 4-ranked, glabrous or nearly so, with marginal cilia. The species is not easy to identify and occasional hybridization occurs. Var. *setulosa* is similar to *C. exilis* subsp. *cooperi* but is distinguished by its hairy, ovate to elliptic leaves and the latter's distinctive fruits; it occurs in the eastern parts of South Africa and Zimbabwe. Var. *jenkinsii* is found in a few places from Rustenberg in the North West to Blouberg in the Northern Province (Transvaal) on the mountains: it forms irregular mats, the erect stems produce vegetative buds as well as a few terminal flowers. Var. *deminuta* produces distinct rosettes of almost erect leaves, glabrous with marginal cilia, the inflorescence spike-like; occurring on mountains in Mpumalanga. Var. *rubra* forms cup-shaped rosettes, the leaves almost membranous to nearly succulent, the leaf sheath funnel-shaped and about 2 mm long; sepals glabrous and petals rounded at the apices; above 500 m along the Drakensberg from the Eastern Cape to Mpumalanga. Var. *rubra* is similar to *C. natalensis*, but the latter is usually a solitary rosette. Var. *longiciliata* is characterised by woody, leafy branches up to 150 mm long which produce leaf rosettes in the resting period; distinguished by the longer marginal hairs (1 mm or more) and found on moist rock faces in the Drakensberg in KwaZulu-Natal and Mpumalanga.

C. natalensis Schönl.: On grassy slopes of the Drakensberg and in central KwaZulu-Natal to the northern Eastern Cape. Perennials or biennials up to 400 mm tall when flowering; spirally arranged

leaves forming several rosettes, old leaves remaining attached to the erect stems. Obovate leaves 15-60 mm long, gradually shortening below the inflorescence. Distinguished by its short petals (2-3 mm) without distinct dorsal appendages, white, tinged pink to red, flowering January to April.

C. vaginata Eckl. & Zeyh.: A robust species which has a tremendous distribution from the Eastern Cape throughout eastern Africa to Ethiopia, usually in grasslands above 800 m. Perennials 160-500 mm tall when in flower, with a spiral leafy rosette from a tuberous root-stock. Leaves lanceolate to linear, 50-250 × 3-20 mm, glabrous to hairy and always with stout, blunt marginal cilia, green to yellow-green. Usually one (rarely more) inflorescence, flat-topped, flowers usually yellow, rarely white (Pilgrim's Rest in Mpumalanga and further north). Distinguished from *C. alba* by its long hairy leaf sheath (8-20 mm) and absence of purple colouration. Further field investigation has resulted in the recognition of subsp. *minuta* (in shallow soil on granite outcrops north of Mbabane, Swaziland) which is much smaller than the typical subspecies; it has 2-5 inflorescences, the leaf lamina 2-3 mm wide, illustrated in the 1985 revision it shows hooded petals without a dorsal appendage.

C. acinaciformis Schinz: On grassy slopes of the escarpment from northern KwaZulu-Natal to Mpumalanga. A handsome perennial or biennial species with basal rosette of yellowish-green, narrowly triangular, sharply acute leaves up to 400 mm long. Up to 1.3 m high when the leafy flowering axis has developed, bearing a flat-topped, densely-flowered inflorescence in pale yellow. Similar to robust specimens of *C. vaginata* but has broad-based teeth or cilia on leaf margins.

C. alba Forssk. Also with an eastern distribution (as in *C. vaginata*) but coastal for the whole of KwaZulu-Natal, extending into tropical and north Africa to Yemen. The name 'alba' meaning white refers to the white-flowering plants from north Africa described by Forsskal in 1775; white flowers are rare in southern Africa, being mostly deep red. It is difficult, from the description, to find other distinguishing characters for *C. alba*. It has similar habit to that of *C. vaginata*, but lacks the tuberous rootstock; the lanceolate leaves (60-150 mm long) are glabrous with recurved or pointed marginal cilia, dark green to yellow-green sometimes with purple, the leaf sheath is 1-3 mm long, whereas in



Crassula acinaciformis – 600 mm tall

C. vaginata it is 8-15 mm long. The flowers of *C. alba* var. *alba* are described as being deep red, pink or white; this variety is illustrated (*Crassulaceae* 14, 1985) and shows a tubular flower with spreading acute lobes which have distinct dorsal appendages. In the same figure, *C. vaginata* subsp. *minuta* has hooded petals without a dorsal appendage. *C. alba* var. *parvisepala* of Mpumalanga has shorter sepals and the corolla is deep red. Var. *pallida* of Swaziland and Mpumalanga also has shorter sepals but its flowers are cream to pale yellow. Some of the description of the complex leaves the reader confused; it needs to be reduced to basic description of discontinuous characters so that positive identifications can be made. The three closely related species all flower from February to April, *C. acinaciformis* continuing into June.

C. southii Schönl.: From southern KwaZulu-Natal to the Eastern Cape. Annuals or perennials, somewhat woody at base, the short triangular leaves and sepals ending in colourless awns. Subsp. *southii* is erect to 250 mm on grassy slopes near the coast in the Eastern Cape, particularly the lower Fish River.



Crassula obovata var. *dregeana*

The flowers are tubular, cream or white. Subsp. *sphaerocephala* is decumbent with sinuous branches up to 150 mm long, leaves very narrow, occurring from King William's Town to southern KwaZulu-Natal.

C. sediflora (Eckl. & Zeyh.) Endl. ex Walp.: KwaZulu-Natal and Eastern Cape. A decumbent species with wiry stems up to 400 mm long, little branched, with very narrow, linear, glabrous leaves 6-15 mm long, these not forming an awn as in the similar *C. southii*. The flowers are tubular, cream, appearing February to May. Var. *sediflora* occurs near Seymour in the Eastern Cape and KwaZulu-Natal. Var. *amatolica* has shorter, broader leaves with distinct cilia, and is recorded from the Amatola mountains.

C. obovata Haw.: KwaZulu-Natal and Eastern Cape. One to several rosettes in young and resting plants, later becoming freely branched. Leaves are very variable, dorsiventrally flattened and gradually shorten below the inflorescence. Similar to *C. setulosa* but differs in having longer petals (5-8 mm) and the branches longer than 200 mm. Var. *obovata* has slightly fleshy leaves with distinct marginal cilia; it occurs on mountains from Somerset East to central KwaZulu-Natal. Var. *dregeana* which grows along the southern KwaZulu-Natal coast has very fleshy leaves densely covered with recurved hairs.

C. brachystachya Tölken: In shaded kloofs in the Witteberg and northern Swartberg in the Western Cape. Produces several rosettes, the erect branches brittle and 100-200 mm long during flowering; narrow, acute leaves shorten just below the spike-like

inflorescence making the peduncle distinct from the stem. The flowers are tubular, the white petals 5-6 mm long with dorsal appendages, stamens with black anthers, flowering November to January.

C. compacta Schönl.: In grassveld on mountains in northern Free State and Transvaal. Small annuals or perennials; rosettes flat on the soil, 30-100 mm high when flowering. Very similar to *C. capitella* but generally distinguished by its reniform ovaries which have distinct short styles.

C. hemisphaerica Thunb.: Present in the Knersvlakte in the west and Little and Great Karoo as far east as Willowmore. Usually a single dwarf rosette 50-120 mm high when flowering. The broad, opposite leaves are glabrous except for the marginal cilia, tightly packed and recurved into a neat hemisphere. The leaves are abruptly shorter on the floral spike which bears numerous white or cream tubular flowers in the spring.

C. capitella Thunb.: Transvaal, Free State and Eastern Cape, to less extent in Namibia and Botswana. A complex species up to 400 mm when flowering, embracing a full range from decumbent plants which rarely form basal rosettes to biennials with one rosette. It differs from most others in section *Rosulares* by its spike-like inflorescence and petals generally under 4 mm in length. It is distinguished from *C. hemisphaerica* by the leaves slowly decreasing in size on the flowering axis. Subsp. *capitella* is often biennial with one rosette not tuberous at the base, leaves often recurved, linear-lanceolate, 20-70 × 10-20 mm. The petals are smooth with fleshy tips and a dorsal appendage, styles absent and broad lateral stigmas; it occurs from the Eastern Cape westwards to the Little Karoo and northwards into the Free State. The glabrous nature of the latter distinguishes it from subsp. *nodulosa* (*Crassula capitella* subsp. *enantiophylla*) which is widespread in the Transvaal, Northern Cape and Botswana; it has hairy, robust, erect stems, hairy bracts and sepals, and is tuberous or woody at its base. Subsp. *meyeri* is a decumbent perennial form becoming woody at the base, stems glabrous or sparsely hairy, styles indistinct and stigmas lateral; occurring on sand dunes along the central KwaZulu-Natal coast. Subsp. *sessilicymula* has a woody base and is found in the shade of trees and shrubs in Transvaal between Pretoria and Naboomspruit. It is distinguished by its flowering branches dividing at the base, and its lanceolate leaves 20-40 × 10-15

mm. Most complex of all is subsp. *thyrsiflora* (*Crassula thyrsiflora*, *C. turrita*, *C. corymbulosa*, *C. muda*, *C. rhodogyna*); it occurs widely in the Western and Eastern Cape Provinces, the Northern Province and south-eastern Namibia. It usually forms basal rosettes but may be decumbent, the leaves are acute-tipped, sepals glabrous, the petals usually have rounded appendages, styles are distinct and insignificant stigmas are terminal. In the Eastern Cape, the brittle leaves shed easily and develop into new plants.

C. barbata Thunb. [colour p. 95]: In the south-western Great Karoo to Prince Albert, also Victoria West in the central karoo. Soft, green, erect leaves form a basal rosette, 30–40 mm in diameter, the leaves obovate, almost as long as broad, with conspicuous marginal hairs 5 mm long. The inflorescence is spike-like and sepals glabrous, the flowers tubular, white to dark pink. Marloth wrote that “plants of *C. barbata* gathered among rocks near Beaufort West as little fluffy lumps, had been kept between the leaves of a book for nine months, when they began to sprout and produce flowers” – one never ceases to be amazed at the way in which so many karoo plants cling to life. It was known that the hydathodes absorbed dew, and he added that “a leaf may absorb in a single night more water in this way than it loses by transpiration in a week”. Subsp. *barbata* occurs from Prince Albert along the Karoo mountains to the eastern Cedarberg; the solitary rosettes always under bushes. In subsp. *broomii*, recorded only from near Victoria West, the leaves are 30–40 mm long, 20–35 mm broad, with much shorter cilia (less than 1 mm).

C. tomentosa Thunb.: Mainly a western coastal species from the Cape Peninsula to southern Namibia, also across the karoo to Laingsburg, and following the Orange River into Bushmanland. Young rosettes are closely packed at first, opening out on flowering and reaching heights of 100–600 mm. In var. *tomentosa* the oblong leaves (20–80 mm long) are densely hairy, the leaves spreading apart as the stem elongates, with a gradual transition to the flowering zone. The sepals are densely hairy, the corolla is tubular, cream to pale yellow, the petals, blunt-ended, spreading or somewhat recurved; stamens with black anthers. As in *C. barbata*, the broad stigma is lateral, the ovaries somewhat sunken. In the smaller, less common var. *glabri-folia*, the leaves are hairy to glabrous, broader and 5–15 mm long, not spreading out on flowering, so

that the erect stem has the appearance of an inflorescence: it is found in southern Namibia and Bushmanland, and southwards along the eastern mountain slopes through Namaqualand to Laingsburg. These smaller plants are similar to *C. barbata*, but the latter has glabrous stems and sepals, and is a solitary rosette, whereas *C. tomentosa* var. *glabri-folia* has several rosettes from the same plant.

15 Section *Perfilatae* Haw. ex DC.

Shrubs with glabrous, woody stems with leaves evenly spaced. The tough, fleshy leaves are rarely ciliate and show a marked fusion of the sessile leaf bases. The small flowers are tubular with recurved petal apices and often with small dorsal appendage. With the exception of *C. fusca*, styles are distinct. Hydathodes are dense along leaf margins and may be scattered on the lamina. Common in dry areas from southern Namibia to the Eastern Cape.

C. fusca Herre: On cool southern aspects of the mountains of the lower Orange River. Sparsely branched shrublets up to 400 mm high with old leaves persistent. The narrow leaves (40–90 × 8–15 mm) are brownish-red, boat-shaped with margins serrulate at first. Flowers white to light pink, in a terminal, pyramidal thyrse; distinguished from others in this section by the sessile stigma.

C. sladenii Schönl.: On both sides of the lower Orange River to Namuskloof in Namibia and in the Richtersveld. Sparsely branched to 400 mm high, often scrambling, old leaves persistent. Ovate leaves 25–40 mm long, held at right angles to the stem, pale greyish-green with yellow or red margin and clasping leaf bases. Similar in appearance to *C. rupestris* but the leaves are much larger. The inflorescence is flat- or round-topped, with numerous white to pinkish flowers just above the leaves, stamens with black anthers.

C. perforata Thunb.: From Worcester in the Western Cape eastwards to central KwaZulu-Natal; common in the Fish River valley in the Eastern Cape. Scrambling narrow plants with unbranched stems to 600 mm long, growing through and over other bushes, leaves ovate and usually glaucous, 8–20 mm long, with red or yellow horny margins, appearing to have the wiry stem pass through the leaf-pair. Inflorescence elongated with numerous small creamy flowers, petals up to 2.5 mm long.

Similar to *C. rupestris*, with which it co-habits, but *C. rupestris* is quite distinct, having a rounded dense inflorescence with leaf-like bracts at the base, and in flower at a different time, June to October, whereas *C. perforata* flowers from November to April.

C. rupestris Thunb. [colour p. 96]: From Vanrhynsdorp in the west to the Fish River valley in the Eastern Cape. Colourful, erect, spreading or decumbent shrublets up to 500 mm high; leaves brownish-red to purple with red or yellow margin. Subsp. *rupestris* is very effective as a landscape plant and hardy, but seldom seen in gardens. Leaves ovate, 5-15 × 3-10 mm, obtuse or rounded, glabrous, leaf bases fused into a fleshy disc. Dense heads of many pink flowers form at the ends of the branches, flowering June to October. Subsp. *marnieriana* is an interesting decumbent, rooting, dwarf form in which the small much-fused leaves are so close together that the stems appear columnar; it is recorded from southern slopes of the Swartberg and Anysberg in the Western Cape karoo. It grows only on Witteberg quartzite, usually on cliffs, where the stems may become pendulous. It lacks variation over its range, except in the Anysberg area (Bruyns in *Aloe* 23(1), 1986). In subsp. *commutata* the leaves are rarely broader than 4 mm, scarcely fused, with internodes apparent, the stems not rooting when reaching the ground, restricted to a small area on the mountains on both sides of the lower Orange River.

C. brevifolia Harv. [colour p. 96]: From south-western Namibia through Namaqualand to Vanrhynsdorp. Much-branched shrublets up to 500 mm. tall, with woody stems, flaking bark and old leaves deciduous. The leaves are very fleshy, almost triangular in section. In subsp. *brevifolia* the internodes are visible between the leaves which are 20-35 mm long, curved upwards with blunt apices, green often with a grey bloom, changing to yellow, red or purple. The inflorescence is rounded, the flowers are lemon-yellow, rarely white, with a papillose ovary. In the smaller subsp. *psammophila* (up to 200 mm high) the internodes are not visible, the leaves are brownish-red without bloom, flowers are pink with glabrous carpels. Found on sandy slopes between Grootmis and the Orange River.

C. macowaniana Schönl. & Bak.f. [colour p. 96]: From south-western Namibia on higher ground through Namaqualand to Clanwilliam. A variable

species showing a range from the typical metre-high shrub to low plants with prostrate stems in the Stinkfontein-Port Nolloth area in the Richtersveld. The leaves are lanceolate to linear, 25-60 × 3-15 mm long, slightly flat above, very convex below, curving upwards, pointed, glabrous, hydathodes indistinct. Inflorescence rounded, flowers whitish-pink with distinctively rounded, ridged, fleshy sepals.

16 Section *Columnares* Haw. ex DC.

Small biennials or perennials with leaves closely piled forming a column around the stem. Little branched and less than 150 mm tall. Sweet-scented flowers are long-tubular in a dense terminal capitulum, usually monocarpic. Occurring in the Little Karoo, Ceres Karoo and Namaqualand.

C. columnaris Thunb. [colour p. 96]: From southern Namibia to Calvinia in the middle-west extending to the Little Karoo. A dwarf species 15-60 mm high in which the grey-green to brownish leaves are concave on the inner or adaxial surface and convex outwardly, arranged in closed ranks, completely enveloping the short stem. As Marloth aptly states, the specific name is unsuitable, as the typical plants in nature are often sunken and globular, only becoming columnar in cultivation. The plant takes five to ten years to reach maturity, at which time, and if rain falls, the round body opens and a dense 'shaving brush' of cream to orange-yellow sweet-scented flowers appears. The plant, being monocarpic, dies after flowering, but this single act must be very successful because the plants are quite common. The typical subspecies is found in the Little Karoo, western Great Karoo and towards Vanrhynsdorp and flowers from May to August. Subsp. *prolifera* is the northern form which occurs in Namaqualand, Bushmanland and southern Namibia and is much branched at the base. To the north of their range the axillary buds break off and root around the parent plant, hence the name 'prolifera'. The main stem extends up to 80 mm especially on flowering and the flower cluster is well above the leaves; flowering July to October.

C. barklyi N.E.Br. [colour p. 96]: Occurs on the western hills of Namaqualand from Vanrhynsdorp to Port Nolloth. Better known by its synonym, *C. teres*, and locally by the common name 'bandaged finger', the latter being aptly descriptive of

the 50-90 mm long stem covered neatly and smoothly by the overlapping leaves which have membranous margins. The stem column is narrower than that of *C. columnaris*, longer and does not die when the inflorescence withers. Unlike its solitary relative, this species branches into several finger-like growths. It flowers from June to August.

C. congesta N.E.Br. [colour p. 96]: In the western Great Karoo between Touws River and Laingsburg, and in the Little Karoo. Small unbranched species 50-150 mm high, with fleshy leaves which become almost terete at the apex, grey-green, glabrous, becoming smaller under the inflorescence which is a terminal capitulum of creamy flowers. Long-maturing in the field, the species is monocarpic. Similar in general habit to *C. columnaris*, but the leaves are pointed and not closely 'piled'. Subsp. *congesta* has leaves curved upward and bluntly acute, and occurs in the Great Karoo. Subsp. *laticephala* has recurved leaves with sharp apices and is found from Barrydale to Oudtshoorn in the Little Karoo.

C. alpestris Thunb. [colour p. 96]: From Nieuwoudtville in the western karoo to east of Worcester. Subsp. *alpestris* is erect from 50-150 mm high, with few branches; the leaves (8-20 mm long) are flattened, leathery and triangular, becoming shorter by almost half their length below the inflorescence; the latter is flat-topped and terminal at the end of each branch. The corolla is ampulliform, white or cream, tinged red. Subsp. *massonii* is larger, erect from 80-250 mm, the leaves (5-8 mm long) all almost equal in length; bearing many rounded axillary inflorescences as well as a small terminal one. Found on southern slopes in two widely separate areas: Laingsburg and Vanrhynsdorp.

C. multiceps Harv.: A very small species 30-60 mm high, which occurs in rock crevices between Vredendal and Bitterfontein in Namaqualand. Its short fleshy roots distinguish it from others in this section, and the narrowly triangular, leathery leaves in whorls of 5-7 are a unique feature in the genus *Crassula*. The inflorescence is a small terminal capitulum of cream or pale yellow flowers, pinkish in bud.

C. pyramidalis Thunb. [colour p. 96]: Southern Great Karoo from the eastern side of the Bokkeveld Mountains to Somerset East in the Eastern Cape. A small, attractive species 30-130 mm tall (sometimes longer) in which the stems are completely

covered by the imbricate, broadly triangular leaves in four precise ranks forming a quadrangular column in green to reddish-brown. When mature a head of creamy white flowers, reddish in bud, appears at the apex of each branch, unfortunately heralding the death of the plant. Field investigations into the varying stem lengths of the species from Somerset East along the southern Karoo to the south-western Cape have brought *Crassula quadrangula*, *C. cylindrica* and *C. archeri* into synonymy here.

17 Section *Argyrophylla* (Schönl.) Tölken

Perennials generally with short erect branches up to 200 mm, woody at base, usually hairy or papillate. Leaves flattened to nearly terete, hydathodes scattered over both surfaces. Flowers in several dense terminal clusters, mostly with a distinct peduncle. The corolla is tubular, lobes with a dorsal appendage.

C. lanuginosa Harv.: Eastern Cape. Var. *lanuginosa* is prostrate and mat-forming, internodes often hidden by the leaves which are 2-7 mm long, hairy, lanceolate, acute, terete or angled. It is distinguished from the very similar *C. swaziensis* and *C. sericea* by its soft stems and absence of distinct peduncle. It occurs from Graaff-Reinet to Aliwal North. Var. *pachystemon* lies to the south of the typical plants. It has larger leaves (15-30 mm long) with rounded apices and the internodes on the decumbent branches are usually visible.

C. decidua Schönl.: Eastern Cape, in karoid vegetation between Somerset East and Cradock. Branches short, erect, up to 250 mm when flowering; leaves flattened, greyish-green, 10-25 mm long with rounded apices, papillate but glabrous later on; their deciduous nature and the spike-like inflorescence distinguish this species from others in section *Argyrophylla*. The flowers are in dense clusters, corolla tubular and white.

C. swaziensis Schönl. (*Crassula globularioides* subsp. *argyrophylla*): From northern Zimbabwe along the mountains of the Transvaal to Swaziland and KwaZulu-Natal. The short erect or decumbent stems up to 250 mm have leaves in a terminal rosette. Leaves are obovate, 20-50 mm long, flattened, hairy, green, glaucous or brown. The inflorescence consists of a number of dense heads of

cream flowers, pink in bud. The plants from Barberton to KwaZulu-Natal have glabrous or glabrescent leaves. Typically the plants are low shrubs, scarcely 200 mm high, with a well defined peduncle 40-100 mm, hairy, as are the sepals of the flowers.

C. sericea Schönl.: From Witputz in southern Namibia along coastal mountains to Komaggas in Namaqualand, and across Bushmanland. Usually erect and more robust than *C. lanuginosa*, distinguished by its woody stems and distinct peduncle. Leaves are usually obovate, densely hairy and greyish-green. The flowers have dorsal appendages. Var. *velutina* has very short stems (about 30 mm long) and occurs at high altitudes on western slopes of the mountains on either side of the lower Orange River; it is distinguished by its yellow acuminate petals usually without dorsal appendages. Var. *sericea* is widespread in Bushmanland and southern Namibia; its densely hairy leaves have a brown margin and the petals have dorsal appendages. Var. *hottentotta* occurs in the shade of rocks from Komaggas to south of Witputz; the leaves are very fleshy, covered with round papillae instead of hairs, grey-green without a brown margin.

C. alstonii Marloth [colour p. 96]: From the Richtersveld to Komaggas in northern Namaqualand. A dwarf species in which the hairy whitish-green leaves are closely pressed together forming a spherical rosette 20-50 mm in diameter, unique in the genus *Crassula*. It is similar to *C. sericea* var. *velutina* and *C. namaquensis* [colour p. 96], but it occupies its own area on the coastal plains and hills. The leaves are covered with adpressed hairs. The hairy peduncle is 20-40 mm long, the flowers tubular, cream to pale yellow, fading to brown.

C. namaquensis Schönl. & Bak.f. [colour p. 96]: From southern Namibia southwards to the Kamiesberg and Cedarberg. Small plants to 100 mm high, having a stout base and clusters of spirally arranged oblong leaves, grey- to bluish-green, old leaves persistent. Subsp. *namaquensis* is distinguished by its stout woody stems and the short, beaked white corolla lobes up to 1 mm long; it occurs from the Kamiesberg to south-eastern Namibia. In subsp. *comptonii* (Nieuwoudtville area) the leaves are nearly terete, the corolla lobes are 2-3 mm long and yellow. Subsp. *lutea* has conical acute leaves 15-30 mm long, the yellow corolla lobes are 7-9 mm long; it occurs in the Swart Ruggens Mountains and



Crassula hirtipes

in the Cedarberg. Flowering between August and November.

C. hirtipes Harv.: On western mountain slopes from Port Nolloth to Vanrhynsdorp in Namaqualand. Brittle stems up to 150 mm long bear clusters of short, succulent almost terete leaves 6-15 mm long, covered with white bristle-like hairs; the peduncle is covered with spreading hairs. In the Vredendal district the leaves vary from hairy to nearly glabrous – the type material of *C. hirtipes* was taken from this spot and described in 1862. The hairy form was described by Schönland in 1910 under the name of *C. hystrix*, which is now a synonym of this species. The peduncle is hairy, 15-25 mm long, few-flowered, the flowers cream to yellow, the petals with beak-like apex and no dorsal appendage.

C. tecta Thunb. [colour p. 96]: Present in the Little Karoo from Montagu to Oudtshoorn and near Willowmore. A small tufted species with obtuse, greyish-green, thick leaves 20-30 mm long, densely covered with white-tipped papillae. The inflorescence consists of a capitate tuft of white flowers at the end of a peduncle about 100 mm tall. It flowers from April to June.

C. ausensis P.C.Hutch. [colour p. 96 and 97]: Namibia, mainly in the south. Short thickened branches give rise to tufted plants although longer branches are sometimes present; this compact species is al-

lied to *C. sericea*, but distinguished by the sharply acute leaves and pedicellate flowers. Subsp. *ausensis* (*Crassula karasana*, *C. littlewoodii*) has tufted, lanceolate or elliptic leaves covered with fine hairs, but without marginal cilia, on very short branches and occurs from west of Aus to the Karasberge. The white to cream flowers are pedicellate. Subsp. *giessii* recorded from near Maltohohe and Helmeringhausen is a small stunted form distinguished by the marginal cilia on the obovate leaves, the flowers are sessile. In 1998 subsp. *titanopsis* Pavelka was described from plants discovered in fissures in quartzitic rocks close to Grünau which lies just south of the Karasberg Mountains. The name was chosen because of its leaf resemblance to *Titanopsis schwantesii* with which it shares its habitat. The depressed leaf rosettes form small clusters 40-60 mm in diameter, the leaves ovate to obovate, the leaf surface finely papillate and covered with raised blister-like spots which increase towards the leaf-tip in red, orange and brown. It flowers in August-September, unlike the other subspecies which flower from March to April. The flowers are white or cream and pedicellate.

C. garibina Marloth: Southern Namibia and the Richtersveld, extending eastwards to Goodhouse. Decumbent with fleshy branches up to 250 mm long bearing linear, acute leaves 20-40 mm long, about 5 mm broad. Subsp. *garibina* is finely pubescent, the hairs on the leaves having globular tips. The peduncle is hairy, 20-40 mm long, the flowers white to cream. Present on mountains on both sides of the Orange River from the mouth to Goodhouse. Subsp. *glabra* which is found in the mountains north-east of Steinkopf is almost completely glabrous. In both subspecies, the inflorescence is almost hidden in the upper leaves, whereas that of *C. ausensis* is held well above them.

C. susannae Rauh & Friedrich [colour p. 97]: Riethuis, Namaqualand. A most unusual species with a turnip-shaped root and rosettes of flattened, canaliculate leaves which only show their truncated apices above the soil. The inflorescence is a capitulum with few sessile, white flowers which are carried well above the exposed leaf-tips; flowering from April to May.

C. mesembryanthemopsis Dinter [colour p. 97]: Localities are widely separated: Cape Cross in central Namibia, Witputz in the south and from the Orange River mouth in the Richtersveld extending

eastwards to Kenhardt in the Northern Cape. Completely buried in the sand except for the blunt, triangular leaf-tips. Very inconspicuous except when it produces a head of scented white flowers which appear from March to May. As in the last species, the root is turnip-shaped.

18 Section *Arta* (Schönl.) Tölken

Perennials with short branches rarely longer than 150 mm. Leaves mostly in four closed ranks giving the stem a column-like appearance. Inflorescence usually round-topped, peduncle 30-150 mm long, short tubular flowers (up to 3 mm) with broad terminal red stigmas, all species flowering from January to April. Common west of the mountains in Namaqualand and south-western Namibia.

C. grisea Schönl. [colour p. 97]: From south-western Namibia to the Kourkamma Mountains south of Komaggas in Namaqualand. An erect species branching from the base which is very distinct from other species of this section because the sharply acute leaves are subdistant and at right angles to the stem, with visible internodes between. Leaves are linear-lanceolate, 20-50 mm long, glabrous, hairy or papillate, greyish-green, brown to orange. The peduncle is 20-100 mm, hairy, the calyx is very fleshy, the corolla tubular, cream becoming brown. The form with coarse papillae tends to have few branches, the glabrous and hairy forms have more branches.

C. elegans Schönl. & Bak.f. [colour p. 97]: Widespread from Vanrhynsdorp in Namaqualand to south-western Namibia. The plants grow on sandy soil, in shade. A small species with obtuse leaves so close-set that no internodes are visible, the plant less than 100 mm when in flower. The leaves are irregular, not in four neat ranks, and eventually shrivel up completely. Subsp. *elegans* has glabrous or hairy leaves, while subsp. *namibensis* from Lüderitz has leaves covered with rounded papillae. The peduncle is 25-60 mm, with recurved hairs, the corolla tubular, cream or white, fading to brown.

C. columella Marloth & Schönl.: Occurs from Kleinsee to Lekkersing in the Richtersveld. The stems 80-100 mm in height are completely enclosed by the close-pressed, broadly ovate, olive-green leaves covered with minute hairs, forming a 4-angled velvety column up to 20 mm in diameter.

Its habit is similar to that of *C. plegmatoides*, but the latter has coarsely papillate leaves. The peduncle is 20-50 mm, hairy, the corolla tubular, cream to pale yellow, fading brown.

C. plegmatoides Friedrich: On quartz gravel from the Buchu Mountains (Boegoeberge) in south-western Namibia to Port Nolloth in Namaqualand. The stem is an unbranching grey column up to 150 mm high when in flower. Similar to *C. columella* but the stem-enclosing, broadly ovate leaves which form a column 10-15 mm in diameter are densely papillate. The name *C. arta* (a synonym of *C. deceptor*) is often wrongly applied to this species. The peduncle is 30-60 mm long and is covered with recurved hairs. The corolla is cream, fading to brown.

C. deceptor Schönl. & Bak.f. [colour p. 97] (*C. cornuta*, *C. arta*): From south-western Namibia and Bushmanland as far east as Kakamas, southwards through Namaqualand to Vanrhynsdorp. The 4-ranked columnar leafy habit is repeated here, to a height of about 70 mm, and 25 mm in diameter. The broadly ovate leaves have hard spherical papillae and the scattered hydathodes are often conspicuous, especially in adverse conditions. The species shows a complete range of leaf form from adpressed, to spreading, to erect leaf apices. The peduncle is 20-80 mm long and covered with round papillae. Corolla is tubular, cream, fading to brown.

19 Section *Crassula* Tölken

Robust, woody plants erect to 1.5 m with old leaves persistent. Leaves dorsiventrally flattened or laterally compressed and narrowly falcate, covered with fine papillae. Inflorescence rounded or flat-topped, flowers tubular with long styles and terminal stigmas. From Eastern Cape and KwaZulu-Natal through the Transvaal lowveld into south-east tropical Africa. *C. perfoliata* is the type species of the genus *Crassula*, one of the most attractive species and often cultivated.

C. perfoliata L. [colour p. 97]: Eastern Cape. A tall, handsome species which exhibits variation of flower colour and leaf form in its varieties: var. *perfoliata* is little branched, 0.6-1.3 m high, with lanceolate leaves erect and canaliculate; the terminal densely-flowered inflorescence appears in the summer, the flowers small (white petals 3-4 mm

long); occurs from north of Port Elizabeth to Graaff-Reinet and Willowmore. Var. *heterotricha* also has small white flowers, these appearing from May to August, but is smaller (400 m tall) and usually branched with erect leaves. It is found from Umtata northwards through KwaZulu-Natal and Transvaal to south-east tropical Africa. Var. *minor* (better known by its synonym, *Crassula falcata*) has bright red flowers and laterally flattened, falcate, greyish leaves, stands 200-500 mm tall and is rarely branched. This popular form prefers rocky habitats from Willowmore to East London, its larger flowers vary from pink to white north of the Kei River. Var. *coccinea* grows in the river valleys between Port Elizabeth and King William's Town; it also has the red, larger flowers but its leaves are lanceolate-triangular, canaliculate and erect to spreading.

20 Section *Globulea* (Haw.) Harv.

Perennials with a wide range of habit from erect up to 600 mm, to dwarf rosettes; hydathodes scattered on both leaf surfaces; mainly distinguished by prominent fleshy appendages on the petals (rarely canaliculate) of the tubular flowers. Widespread from south-western Namibia to the Eastern Cape and the Drakensberg range.

C. mesembryanthoides (Haw.) Dietr.: Much-branched shrublets to 400 mm high, with peeling bark. The leaves are tapering, acute, covered with backward-pointing whitish bristles. Inflorescence round- to flat-topped, petals with terminal dorsal appendages but without membranous tips, the white to cream flowers appear from March to June. Subsp. *mesembryanthoides* grows among karoid scrub from Port Elizabeth to Graaff-Reinet. Subsp. *hispidula* which occurs in cooler areas between Grahamstown and King William's Town is distinguished by its longer leaves (30-50 mm) which are abruptly shortened below the inflorescence, starts flowering in February, and selects shaded areas while the typical plants grow on exposed hillsides.

C. mollis Thunb.: On mountains between Oudtshoorn in the Little Karoo and Grahamstown in the Eastern Cape. Shrubby to 500 mm, with peeling bark and narrow thickish leaves, as in *C. mesembryanthoides* but distinguished by its soft, very short hairs, hence its name, *mollis*, meaning 'soft'. The leaves are 10-20 mm long, grey. Inflorescence

round-topped, with several to many globular flower clusters, the flowers cream, the stamens with black anthers, flowering in December.

C. latibracteata Tölken: Occurs mainly near Grahamstown. Shrubby to 400 mm high, with peeling bark and obovate leaves turned to one side of the stem, 10-20 mm long, flattened, green or yellowish-green and often with red margins. The inflorescence is flat-topped, almost capitate, with conspicuous, broad, obovate bracts. The corolla is cream, anthers yellow, flowering from February to May. It is similar to *C. cultrata*, but the latter has an elongated inflorescence and flowers from December to January.

C. cultrata L. [colour p. 97]: In rocky terrain from Ladismith in the Little Karoo to the Eastern Cape and southern KwaZulu-Natal. Shrubs from 200-800 mm high, yellowish-green leaves dorsiventrally flattened with a sharp horny reddish margin, oblanceolate to cultrate (knife-shaped), deciduous. Inflorescence elongated with one terminal and several axillary loose clusters of flowers. The corolla is cream, the anthers black and flowering is from December to January.

C. pubescens Thunb.: From the Cedarberg to the Little Karoo and the Eastern Cape. Small semi-shrubs up to 400 mm high with fragile stems and variable leaves, pubescent to glabrous. Var. *pubescens* has a western distribution, is distinguished by its erect habit without adventitious roots, a rounded inflorescence and petal appendages twice as long as broad and elongate-elliptic, the corolla cream to pale yellow. Subsp. *radicans* has glabrous leaves, delicate decumbent branches and spherical petal appendages; present in shade in valleys between Port Elizabeth and King William's Town. Subsp. *ratrayi* is rosulate with short branches, no adventitious roots, leaves covered with short, erect hairs and inflorescence often elongated; on dry mountainsides from Graaff-Reinet to Tarkastad in the Eastern Cape. The leaves are obovate to oblanceolate, 20-40 mm, velvety, the dorsal petal appendage almost spherical.

C. rogersii Schönl.: Extending from Willowmore to Port Alfred in the Eastern Cape. Much-branched shrublets up to 300 mm high; the erect and later decumbent branches bearing hairy, opposite leaves, oblanceolate to club-shaped, 15-20 mm long. The inflorescence is elongated, with many globular

clusters of pale yellow flowers, the petals with ovoid dorsal appendage, the anthers are dark brown. The species is very similar to hairy forms of *C. cultrata* [colour p. 97], but has smaller leaves which are very convex below; the two species when occurring together are distinct, in these cases *C. cultrata* being erect and glabrous.

C. atropurpurea (Haw.) Dietr.: Widely distributed from south-western Namibia to the Eastern Cape. Shrubs up to 600 mm high, fleshy to woody stems; sessile leaves in a rosette, or spaced along the erect stem. Var. *atropurpurea* (*C. clavifolia*, *C. smutsii*) extends from Swellendam along the coast and Langkloof to Port Elizabeth; erect with glabrous, oblanceolate, green leaves turning deep red; petals canaliculate at the tips and 3-5 bracts without axillary flowers on the peduncle. Var. *cultriformis* is shortly erect or decumbent, similar to var. *atropurpurea* but the first internodes of lateral branches are much elongated; it is found along the coast north of Garies in Namaqualand. The other varieties have hairy leaves: var. *purcelli* is found on the northern slopes of the Witteberg and the eastern Cedarberg. It has robust erect habit and its leaves are as thick as broad and covered with adpressed hairs. Var. *watermeyeri* of Namaqualand has the same habit, but has erect hairs, the leaves are dorsiventrally compressed and the petals have a long canaliculate non-membranous apex. Var. *anomala* occurs on the Worcester Mountains and eastwards to Montagu; the leaves are obovate, densely hairy, green turning yellow on erect or decumbent branches. The petals have prominent dorsal appendages somewhat canaliculate with membranous tips. Var. *rubella* (*Crassula clavifolia* var. *muirii*) from the eastern Cedarberg along the northern Little Karoo to Prince Albert in the Great Karoo. The erect stems are 2-4 mm thick, hairy, wiry, with obovate, grey-green, brown or red leaves which have recurved hairs and marginal cilia, vegetatively it is the same as var. *atropurpurea*, with slight floral differences.

C. subaphylla (Eckl. & Zeyh.) Harv.: Recorded from central Namibia but commoner in the south, and from northern Namaqualand to the southern Cape and Eastern Cape. Erect or decumbent to a height of 800 mm, with wiry, woody branches, bark flaking. Leaves linear to lanceolate (8-15 mm long), hairy, rarely papillose to glabrous, shedding easily. The inflorescence is elongated and the wings on either side of the fleshy petal tips are re-

flexed, corolla tubular, cream. Var. *subaphylla* (*Crassula incana*, *C. remota*) has a wide distribution from Namibia into the Western and Eastern Cape Provinces. Its habit is decumbent and the spreading leaves minutely hairy. Var. *virgata* is stiffly erect and twiggy, the leaves glabrous, narrow and curved upwards; occurring in western Namaqualand.

C. ammophila Tölken: From Holgat River in the Richtersveld to Saldanah Bay in the south-western Cape, rarely collected because it grows in coastal scrub and is hidden. Scrambling shrublets with brittle branches up to 800 mm long, old leaves deciduous. Leaves oblong-lanceolate up to 15 mm long and densely covered with recurved hairs. Petals canaliculate and without dorsal ridges. Closely allied to *Crassula subaphylla*.

C. cotyledonis Thunb.: Namaqualand, Western and Eastern Cape. Sparsely branched basal rosette of leaves which are grey-green, broadly ovate (narrower in Karoo) up to 60 mm long, 25 mm broad, dorsiventrally flattened, densely pubescent and with short marginal cilia. Inflorescence elongate with flowers in dense round clusters; the flower a typical *Globulea*-type in which the petals have large round to oblong terminal dorsal appendages with membranous apices turned inwards. This tends to close the mouth of the flower, which is forced open by the proboscis of bees and flies. Closely allied to *Crassula nudicaulis*; flowering November to January.

C. clavata N.E.Br.: Common on the mountains west of the Tanqua Karoo, in the southern Great Karoo as far as Prince Albert. Produces several small rosettes of glabrous leaves (pubescent in northern Namaqualand) 20–40 mm long, up to 13 mm broad. The leaves are usually flat on the ground, less often erect, distinguished from related species by their deep purplish-red colour. In the Knersvlakte the species becomes more robust. Co-

rolla is cream to pale yellow, each petal with a spherical dorsal appendage.

C. subacaulis Schönl. & Bak.f. (*Crassula erosula*): From south-western Namibia along coastal mountains to Clanwilliam in the Western Cape. Often scramblers or tufted and rarely erect shrublets, the leaves brown to deep red and usually glabrous as in the very similar *Crassula clavata*; narrowly oblong and 30–80 mm long. Both species have paired, narrow bracts on the peduncle, forming an obtuse angle at their base, which feature distinguishes them from *C. nudicaulis* where the angle of fusion is acute. Subsp. *subacaulis* is restricted to the Richtersveld where the plants form dense tufts up to 300 mm in diameter, stems repeatedly branching. The peduncle is 150–400 mm long, with dense dichasia of cream to pale yellow flowers. Subsp. *erosula* is an erect, branching plant to 300 mm high, with internodes visible. It extends from Namibia to near Clanwilliam.

C. nudicaulis L. [colour p. 97]: This species carries a large synonymy and has a wide distribution from the south-western Cape to the Eastern Cape, Free State, Lesotho and KwaZulu-Natal. It forms several basal rosettes with thickened taproot, the leaves turn brown but never brick-red as in the last two species. Inflorescence is spike-like with 1–3 pairs of bracts without axillary flowers; the petals with prominent terminal dorsal appendages. In var. *nudicaulis* the leaves are oblong-elliptic and 50–80 mm long. The typical variety represents a variable complex. Var. *herrei* is a shrublet 100–250 mm tall, with very thick glabrous leaves 30–40 mm long and semi-circular in section; the flowers are directed upwards. It occurs on coastal hills in the Western Cape as far north as the Orange River. Var. *platyphylla* is found in the mountains bordering the southern Great Karoo; distinguished by its bluish-grey, broadly oblong to orbicular leaves with sub-distant marginal cilia.

*Cotyledon campanulata* (p. 54)*Cotyledon woodii* (p. 54)*Cotyledon tomentosa* subsp. *tomentosa* (p. 54)*Cotyledon tomentosa* subsp. *ladismithiensis* (p. 54)*Cotyledon orbiculata* (p. 54)*Cotyledon orbiculata* (p. 54)*Cotyledon cuneata* (p. 54)*Tylecodon occultans* (p. 58)*Tylecodon torulosus* (p. 63)*Cotyledon papillaris* (p. 55)*Tylecodon ellaphieae* (p. 57) (centre)*Tylecodon pusillus* (p. 58) (right)



Tylecodon sulphureus,
near Pofadder (p. 59)



Tylecodon wallichii subsp.
ecklonianus (p. 61, 63)



Tylecodon racemosus (p. 61)



Tylecodon reticulatus subsp.
reticulatus (p. 62, 63)



Tylecodon cacalioides
(p. 64)



Tylecodon paniculatus
(p. 61, 64)



Adromischus leucophyllus (p. 68)



Adromischus leucophyllus (p. 68)



Adromischus montium-kinghardii (p. 65)



Adromischus triflorus with
Gibbaeum pubescens (p. 68)



Adromischus caryophyllaceus (p. 67)



Adromischus caryophyllaceus (p. 67)



Adromischus phillipsiae (p. 67)



Adromischus marianiae var.
immaculatus (p. 69)



Crassula expansa (p. 74)



Crassula corallina (p. 75)



Crassula deltoidea (p. 75)



Crassula streyi (p. 76)



Crassula simulans (p. 77)



Crassula orbicularis with *Holothrix villosa* (p. 81)



Crassula peploides (p. 77)



Crassula montana (p. 81)

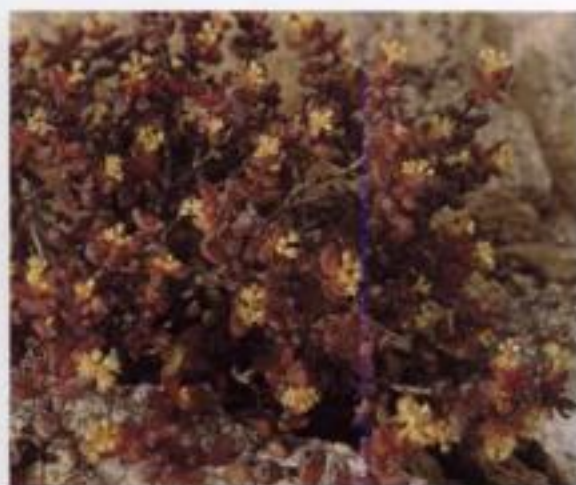
Crassula ericoides (p. 78)



Crassula barbata (p. 85)



Crassula rupestris subsp.
marnieriana (p. 86)



Crassula brevifolia (p. 86)



Crassula macowaniana (p. 86)



Crassula columnaris (p. 86)



Crassula congesta (p. 87)



Crassula alpestris (p. 87)



Crassula pyramidalis
(p. 87)



Crassula ausesis subsp. *ausensis*
(p. 88)



Crassula barklyi (p. 86)



Crassula namaquensis (p. 88)



Crassula alstonii (p. 88)



Crassula tecta (p. 88)



Crassula ausensis subsp. *giessii* (p. 89)



Crassula susannae (p. 89)



Crassula mesembryanthemopsis
(p. 89)



Crassula grisea (p. 89)



Crassula elegans (p. 89)



Crassula deceptor (p. 90)



Crassula perfoliata var. *minor* (pink form) (p. 90)



Crassula perfoliata var. *coccinea*
(p. 90)



Crassula nudicaulis var. *herrei* (p. 92)



Crassula nudicaulis var. *platyphylla*
(p. 92)



Crassula cultrata (p. 91)



Euphorbia mauritanica (p. 110)



Euphorbia suffulta (p. 111)



Euphorbia dregeana (p. 111)



Euphorbia quadrata (p. 111)



Euphorbia gregaria, Namibia (p. 111)



Euphorbia damarana, capsules (p. 111)

Euphorbia damarana (p. 111)



Euphorbia lignosa, Namibia (p. 112)



Euphorbia decussata (p. 112)



Euphorbia herrei (p. 114)



Euphorbia juttae (p. 114)



Euphorbia celata (p. 115)



Euphorbia stapelioides (p. 112)



Euphorbia hamata (p. 115)



Euphorbia mira (p. 116)



Euphorbia clandestina (p. 117)



Euphorbia monteiri subsp.
brandbergensis (p. 118)



Euphorbia eustacei, in spring (p. 119)



Euphorbia schoenlandii (p. 119)



Euphorbia multifolia (p. 119)



Euphorbia eustacei, in summer (p. 119)



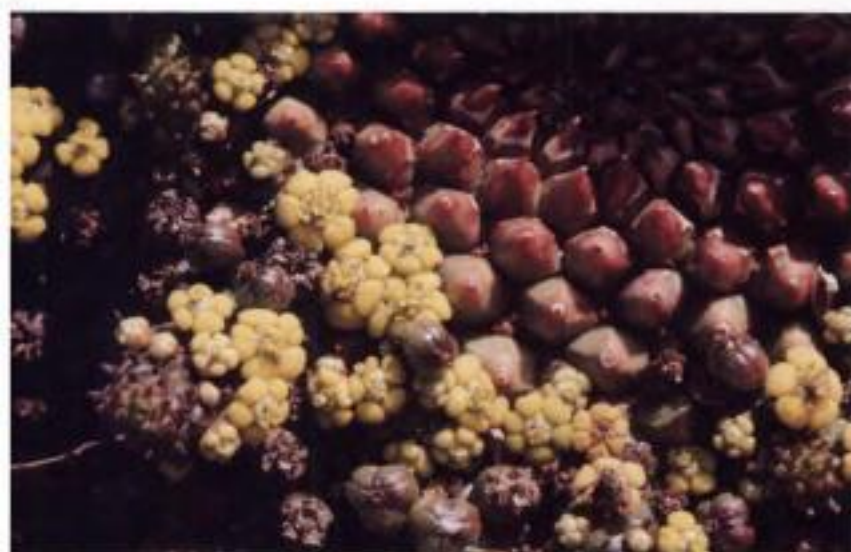
Euphorbia restituta (p. 119)



Euphorbia clavaroides at 8000 feet (p. 119)



Euphorbia esculenta (p. 120)



Euphorbia woodii (p. 120)



Euphorbia woodii (p. 120)



Euphorbia marlothiana (p. 121)



Euphorbia caput-medusae (p. 121)



Euphorbia tuberculata (p. 121)



Euphorbia ramiglans (p. 122)



Euphorbia tuberculata, cyathia with
fingering glands (p. 121)



Euphorbia friedrichiae (p. 123)



Euphorbia multiceps (p. 123)



Euphorbia brakdamensis, west of Springbok (p. 124)



Euphorbia rudis (p. 124)



Euphorbia davyi (p. 124, 146)



Euphorbia tridentata (p. 125)



Euphorbia wilmaniae (p. 125)



Euphorbia polycephala at Cranemere (p. 125)



Euphorbia polycephala, flat form (p. 125)



Euphorbia polycephala, compacted stem ends with capsules
(p. 125)



Euphorbia obesa subsp. *symmetrica* (p. 126)



Euphorbia meloformis subsp.
meloformis (p. 126)



Euphorbia meloformis subsp. *valida* (p. 127)



Euphorbia pseudoglobosa (p. 127)



Euphorbia susannae (p. 127)



Euphorbia enopla (p. 129)



Euphorbia enopla, *cyathia* (p. 129)



Euphorbia polygona (p. 129)



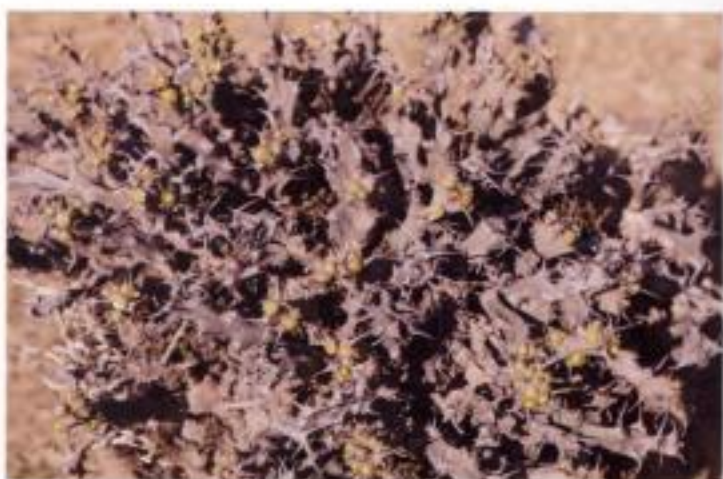
Euphorbia horrida (p. 129)



Euphorbia stellispina (p. 130)



Euphorbia waterbergensis (p. 133)



Euphorbia schinzii (p. 131, 146)



Euphorbia venenata (p. 134)



Euphorbia virosa (p. 133, 139)



Euphorbia avasmontana (p. 134)



Euphorbia coerulescens (p. 135)



Euphorbia evansii (p. 137)



Euphorbia triangularis (p. 138)



Euphorbia cooperi var. *cooperi* (p. 135, 143)



Euphorbia ingens (p. 138, 143)



Euphorbia tetragona (p. 138)

Euphorbia grandialata (p. 135)



Euphorbia teixeirae (p. 139)



Euphorbia opuntioides (p. 141)



Euphorbia coerulans (p. 142)



Euphorbia halipedicola (p. 144, 147)



Euphorbia persistentifolia (p. 145)



Euphorbia wildii, 1.7 m tall on the dyke, Zimbabwe (p. 145)



Euphorbia wildii (p. 145)



Euphorbia rugosiflora (p. 146)



Euphorbia bougheyi (p. 147)



Euphorbia decidua, in cultivation (p. 146)



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Monadenium mafingense (p. 152)

Monadenium schubertii (p. 151)

Euphorbiaceae

Euphorbia and related genera

The genus **Euphorbia** was described by Linnaeus in 1753. It consists of more than 2000 species which vary in habit from small annual herbs to large trees. It includes about 1300 herbaceous 'spurges' which have spread to all continents. The true succulent euphorbias occur in India, Arabia, throughout Africa and adjacent Canary Islands and Madagascar. In Africa *Euphorbia* certainly excels at every bizarre venture into survival kit, but the weedy species and woody trees and shrubs also share the African sunlight. This work endeavours to give a picture of succulents from seven African countries: checklists are obtainable from only three of these countries, and they faithfully list *Euphorbia* in all its guises. By sifting all available information some 243 succulent species of *Euphorbia* are presented here.

The Euphorbieae were reviewed by Dr N.E. Brown in *Flora of Tropical Africa* (1911-1913) and in *Flora Capensis* (1915). At least 60 of the succulent *Euphorbia* species of this region bear his name as author. Dr Rudolph Marloth by dint of superb publications maintained subsequent interest in the succulents and is the author of at least 17 of the *Euphorbia* species covered here. The next great revision of the southern euphorbias was undertaken by Alain White, R. Allen Dyer and Boyd L. Sloane (1941). R.A. Dyer, the South African member of the team, described (under his own name, or with those of his co-workers, White and Sloane) 53 of the succulent species. Their two volume work did not cover the tropical euphorbias, which at that stage were largely undescribed. Plans to follow *The Succulent Euphorbieae* (Southern Africa) by further volumes covering the tropical African species were abandoned when Alain White's health started to fail. Onto the scene, in 1958, came Larry Leach, a rare amateur who made it his business to understand and adopt professional taxonomic techniques and used this superbly in his descriptions of the

Euphorbieae (and Stapelieae) of southern and central Africa, as well as Tanzania and Kenya. His journeys were impressive. The author once asked him how he managed for sustenance in remote parts of Angola. He answered: "I always travel with a small pot, and try to obtain an egg or two from the local inhabitants". He was a man in a hurry, impatient to get on; he was meticulous about covering all new material and must have known that he was equipped in every way to revise the succulent Euphorbieae. But time ran out. In this work at least 65 *Euphorbia* species bear his name as author.

Euphorbias are easy to recognise. Dwarf species may be overlooked but the tall spiny giants of the eastern regions stand out in a dominant manner. They are the African counterpart of the American cacti; dealing with similar problems of aridity these unrelated genera have independently developed superficial similarities (as for example, stem angles and thorns), a phenomenon known as convergence. Euphorbias are easily distinguished from cacti by their milky latex (often poisonous) and their small, very specialised flowers.

Euphorbia is the type genus of a large, widespread family called the Euphorbiaceae. This in itself is a surprise, since its floral structure is not shared by any other genera in the family apart from a few closely related ones, like *Monadenium* and *Synadenium*. Other members are the well-known Castor Oil plant, *Ricinus communis*, and the valuable rubber plant, *Hevea brasiliensis*. An interesting member is the Sandbox tree, *Hura crepitans*, a shade tree of the Panama Canal area, so-called because its dried capsules were kept for containing sand used in the old days for blotting ink. Like many euphorbias, its latex is poisonous.

Historians record that King Juba II of Mauritania married the daughter of Antony and Cleopatra. More relevant here is the fact that, according to Pliny, King Juba discovered a plant species on the

Atlas Mountains which he named *Euphorbos*, after his physician, the meaning of the name being 'well fed'. It is possible that the plant King Juba found was *E. resinifera*, also known as 'Morocco mound', which occurs in great rounded masses east of Marrakesh.

The common possession of all euphorbias and one of their chief taxonomic features is the quaint, complex floral arrangement called a cyathium, which means 'cup', and this is the unit of the inflorescence. It is made up of an involucre which usually encloses one female flower and many male flowers which are arranged in five groups. There may be 21 very reduced flowers in one cyathium, which may be unisexual (containing only male flowers or only one female flower) or bisexual, when it contains both male and female flowers. The involucre has protective bracts below and divides above to form a series of lobes and nectaries which are called glands. These glands which secrete scented nectar are usually conspicuous and brightly coloured, most often a warm yellow. Normally the unit has five lobes and five glands, except in the related genera *Monadenium* and *Synadenium* in which the whole series is fused into one gland. The female flower possesses a three-chambered ovary which usually ripens into an explosive capsule, and three bifid styles joined along part of their length. Each tiny male flower, reduced to a stalked stamen, is generally set into the axil of a bracteole; sometimes there are so many feathery bracteoles that they fill the involucre, in some cases to a showy extent, as in *E. inermis* of the Fish River valley in the Eastern Cape. It is usual for the female flower to ripen first and to push itself out of the involucre, encouraging cross-pollination. The male flowers then mature in succession; if a cyathium is opened up it can be seen that the male flowers are at all stages of development. A cluster of cyathia forms a cyme, and the stalk of the cyme is the peduncle. In some species the peduncles persist after flowering, and may harden to form true spines.

The species which follow are arranged in groups roughly in accordance with the order given in *The Succulent Euphorbieae* (White, Dyer & Sloane 1941). South African and Namibian species have been treated together, followed by the Angolan, Zimbabwean, Mozambique and Zambian species.

The euphorbias fall into two main groups: the species in which spines are absent, or, if present, are the modified persistent peduncles or axillary short shoots; these have the more limited distribution and, apart from a few exceptions, occur south

of the Cunene and Limpopo rivers; secondly, the species with paired spines of various origin; these have a much larger distribution, occurring in India, Arabia and throughout Africa. The less succulent, woody trees and shrubs are largely omitted. In the absence of a modern revision, informal headings are given above groups of related species to guide the reader to the correct name.

SOUTH AFRICAN AND NAMIBIAN SPECIES

1 Plants without spines except as short shoots some of which are modified peduncles

Spineless dwarf to tall shrubs with round, rod-like or jointed stems, the tubercles absent or indistinct

E. mauritanica L. [colour p. 98]: The common yellow 'melkbos' or pencil *Euphorbia* is widely spread in the Cape, Kwazulu-Natal and Namibia and is typical of the bushy euphorbias which have rod-like stems. The plant is densely branched up to 1 m and sometimes 2 m in height. The 'melkbos' has a deservedly bad reputation: many Karoo children have regretted snapping the stem and suffering the painful effects of the virulent latex in their eyes. *E. mauritanica* is typically a large yellowish-stemmed bush, quite handsome in flower, when after winter rains in the western karoo it develops pale green leaves terminally, each stem topped with a male cyathium which does not mature or is absent, and surrounding it, 5-6 spreading, yellow, bisexual cyathia on 10 mm pedicels. The 5 glands are usually 1 mm apart, and look like small saucers, often ochre-yellow; the capsule green and well exerted. But all these characters may vary slightly; the above observations apply to a large population in the Robertson Karoo. *E. mauritanica* is variable and a number of varieties have been described, the most substantial of these being var. *lignosa*, coastal from Lüderitz Bay to northern Namaqualand in which the branches become woody. Var. *namaquensis* is very close to the typical, while var. *minor* (Laingsburg & Prince Albert) is smaller, slightly glaucous and palatable to browsing animals; var. *foetens* of southern Namibia (Aus) has thick succulent stems, but its latex is not markedly different from the rest. Var. *corallothamnus* is a new combination of Dinter's *E. corallothamnus*, applied to material which, according to White, Dyer and Slo-

ane, is typically *E. mauritanica*; however, its separate involucre glands certainly do not separate it from the rest of this ubiquitous species.

E. stolonifera Marloth: From the Laingsburg district in the Western Cape to the Richtersveld and southern Namibia. A close relative of *E. mauritanica* especially with regard to the inflorescence, but a much smaller plant, usually less than 500 mm in height. The stems are glaucous to dark green. As its name suggests, it spreads laterally by means of underground stems, a feature absent in *E. mauritanica*.

E. quadrata Nel (*E. francescae*) [colour p. 98]: Located at the summit and sides of Vandersterrberg in the Stinkfontein Mountains in the Richtersveld. A densely branched bisexual shrub or shrublet which is dwarfed when exposed but reaches up to 1 m lower down the mountains when protected by other bushes from intensive grazing and the elements. It is tuberous, the aerial stems are reddish-purple when young, becoming striated by the splitting of this bark, the stems turning greyish and "somewhat rubbery ...not becoming truly woody" (Bruyns in *Bothalia* 22(1), 1992). The inflorescence is a terminal bracteate pseudo-umbel (as in *E. mauritanica*). The female flower is erect for about 10 days then exserts downwards through the gap left by the missing 5th gland; if fertilised it becomes erect again. This species is included here because little was known about it when *The Succulent Euphorbiae* (White, Dyer and Sloane) appeared in 1941, and in 1984 the new species *E. francescae* from the same locality was described by Leach; in 1992 the latter was placed in synonymy by Bruyns. It is contended that the exposed dwarfed plants at the summit of the mountains which Leach described are depauperate specimens of *E. quadrata* and diagrams and comparative description support this view.

E. burmannii E.Mey.: Widespread in both Western and Eastern Cape. Known as the 'Steenbok melkbos' as its young, succulent stems are eaten by goats, sheep and the Cape Steenbuck. The bush has opposite branches and reaches a height of 300-700 mm. It often grows with *E. mauritanica*, but is easily distinguished by its slender green stems and most importantly, the paired dark reddish glands marking the nodes. ***E. karroensis*** (Boiss.) N.E.Br. of Namaqualand appears to be very close to *E. burmannii*, also having large stipular glands at the

nodes. It is differentiated from the latter species by its shorter, thicker stems and sessile cymes; in *E. burmannii* the cymes are pedunculate.

E. suffulta Bruyns [colour p. 98]: Western Cape: from Merweville to west of Rietbron in the southern Great Karoo. A unisexual, scandent species with woody rootstock which gives rise to terete, unarmed stems (3-5 mm diam.) up to 1.3 m long with rudimentary deciduous leaves. Like *E. burmannii* it possesses brown stipular glands (but in this case tuberculate) on either side of the leaf base; but *E. burmannii* is an erect plant, and in addition has (under magnification) smooth stem surface, whereas in *E. suffulta* the surface is bristly. Its general habit is spreading, leaning, ascending when bushes are reached. It is probably, like *E. burmannii*, a delectable grazing item. The cyathium is terminal, solitary, the 5 glands yellow-green, the capsule pubescent and not exserted.

E. dregeana E.Mey. [colour p. 98]: Extends over wide areas of arid country from Tschaukaib in Namibia to the Richtersveld and as far south as Komaggas in Namaqualand. At all times a conspicuous feature in the veld because of its large size: erect from 1-2 m in height with branches from 20-50 mm thick, the leaves alternate and early deciduous. The smooth, whitish-green stems topped with umbels of flowers make it an attractive plant.

E. gummifera Boiss., ***E. gregaria*** Marloth [colour p. 98] and ***E. damarana*** Leach [colour p. 98]: Extensive travelling in Namaqualand, the Namib desert and the Kaokoveld in Namibia by L.C. Leach of Salisbury has resulted in a new look at the distribution of the species *E. gummifera* and *E. gregaria* and the publishing in 1975 of a new species, *E. damarana*. ***E. gummifera*** forms a large, rounded bush mainly present in a coastal strip of less than 80 km wide from Port Nolloth to Lüderitz Bay. It has hard, woody stems which are ribbed, in contrast to the rounded stems of the other two species. It is further distinguished from the other two by the possession of small red cyathia. ***E. gregaria*** extends over a wide area further inland on both sides of the Orange River and northwards to the Fish River Canyon and Seeheim in Namibia. Although *E. gregaria* is very similar to ***E. damarana*** in habit, the two species differ distinctly when in fruit. *E. gregaria* has capsules with long pedicels (15 mm) which allow the ripe fruits to take up a marked drooping position at the stem apex. The pedicel of the cap-

sule of *E. damarana* on the other hand is only 4 mm long. This plant is the tallest of the three related species and is also the most northerly placed, occurring in desert areas north of Swakopmund. More than 300 km separate *E. damarana* from its two relatives in the south.

E. lignosa Marloth [colour p. 99]: Widely distributed on the eastern edge of the Namib desert and Great Karas Mountains in Namibia. It was discovered in 1908 by Dr Rudolph Marloth near Tschau-kaib. Its name derives from the word 'lignum' meaning wood. The plant is a small, rounded, spiky shrub (up to 300 mm tall) which, after rain, blooms attractively, the cyathia solitary or in cymes of 2-3, each gland extended by tiny finger-like processes. The tips of the new branches harden and dry out to form woody spines – an unusual origin of a familiar means of defence amongst the Euphorbieae.

E. spinea N.E. Br.: Occurs near Kanus in Namibia and is common in western Bushmanland (Northern Cape). This is another dwarf species with spine-tipped branches, but is readily distinguished from *E. lignosa* by its much smaller cyathia and by having opposite branches and leaves, whereas in *E. lignosa* the arrangement of both is alternate. It is not closely related to the latter and is part of the *E. decussata* complex. Its leaves are rudimentary, deciduous, ovate or deltoid and blackish-purple. Cymes are carried laterally on the upper branches, the tiny cyathia purple, the glands entire.

E. decussata E.Mey. [colour p. 99]: Occurs on both sides of the Orange River in Namaqualand and the Great Karasberg region in the north. The branch tips taper to a point but do not form spines. It forms a fairly large shrub up to 1 m in height. The primary stems are up to 8 mm thick, widely spreading, rigid, the younger branches succulent, opposite, up to 5 mm thick. Leaves are scale-like, darkening and deciduous. The word 'decussate' refers to the arrangement of the stems. ***E. brachiata*** E.Mey. of Vanrhynsdorp is a dwarf shrublet of much the same construction, with widely divergent opposite branches.

E. chersina N.E.Br.: Occurs from Lüderitz southwards into the Richtersveld, and further south as far as Bitterfontein, which would include the plants described as *E. amarifontana* by N.E. Brown. It is a large spineless, rounded bush up to 600 mm in height, repeatedly branching from the base up-

wards. The branches are rigid and woody, with a fleshy bark. The cymes are terminal on the forked branchlets, and are very small. Many of the rod-like euphorbias develop this divergent habit of forked branching, which gives the plant an open, sprawling appearance. An interesting feature of these euphorbias is their distribution which is almost completely western; apart from the widespread *E. mauritanica* the few exceptions invading the eastern areas include *E. caterviflora* N.E.Br. a spineless dwarf which extends from the south-western Cape to the Cradock and Albany districts, *E. mundii* N.E.Br. which also extends eastwards from Laingsburg and *E. rhombifolia* Boiss., a dense bush of erect unbranching secondary stems which occurs in the Eastern Cape and the Mooi River valley in KwaZulu-Natal. The straight, round, leafless stem of the pencil Euphorbieae would seem to be the ideal habit for coping with adverse conditions of heat and drought.

E. lumbricalis Leach: Occurs in the western Knersvlakte, and northwards, in Namaqualand. *Lumbricus* is the name of the common earthworm; here it describes the smooth, slender procumbent stems of this small rhizomatous species. The dioecious plants have slender, carrot-like tubers from which the stem branches and spreads, re-branching, especially distally, half-erect to about 80 mm. The stems are green or purplish, soft, jointed at their origin, the nodes barely discernable. The involucre has 5 upright glands, the capsule is dark green and sparsely hairy.

E. bayeri Leach: Present in arid patches within the fynbos near Mossel Bay in the Western Cape. A dioecious, much branched, creeping dwarf species which, like *E. lumbricalis*, is rhizomatous. The obscurely angled, rounded stems about 4 mm thick may reach 120 mm in height. It has certain unique characters: the 1 mm long leaves and bracts have several sharp teeth, the 3 mm high glabrous capsule is seated on a densely hairy perianth and its creeping habit is not found elsewhere in the genus. It differs from *E. lumbricalis* further in its obscurely angled branches and spreading involucre glands.

E. stapelioides Boiss. [colour p. 99]: Namaqualand: Orange River mouth and Alexander Bay. A coastal species occurring on calcareous outcrops, with tuberous root and branching rhizomes which produce a few, short, fingerlike, aerial stems 75-100 mm, longer when in the shade. The plant body is

largely buried. The stems are fibrous and, unlike some related species, cannot be broken easily. Apparently dioecious; the terminal cymes have short peduncles, the cymes and cyathia have opposite paired bracts; the cyathium has 5 entire glands. According to Bruyns (pers. comm.) *E. lumbricalis* belongs here.

E. lavrani Leach: Namibia. Published in 1981 from material collected by Lavranos and Newton near Rosh Pinah in 1978. In the dried state it was first confused with *E. jutta*, but later it was found to differ from the latter in its subwoody branches narrowing to a short apex, and in its dark red, marcescent (withering without falling) leaves, although it is difficult to imagine very small leaves sessile and hastate at the same time as recorded by Leach. The stem tubercles are decussate and obtuse. The species is dioecious, the inflorescence terminal, pubescent, with many cyathia; this succulent shrublet, only up to 200 mm tall, is also recorded as having 4 or 5 spreading involucre glands, often 4 and a half! Surely a first in *Euphorbia* description. *E. lavrani* is part of the large *E. decussata* complex, as are the other species described above.

E. giessii Leach: Coastal areas between Kuiseb and Unjab Rivers in Namibia. A dioecious shrublet which branches from the base up to 500 mm or more tall; the succulent stems glaucous, without spines and widely divergent, branching decussately (alternately opposite). The leaves fall early, leaving brown scars. Notable in the male cyathium are the long white hairs in the involucre, the capsules of the female are pedicellate and hairy. The species is related to *E. negromontana* of southern Angola, but distinguished from it by being more robust, with fleshy bracts and larger capsule; it is also related to the broom-like *E. spartaria* of higher altitudes (Windhoek and Rehoboth areas) but distinguished from the latter by its smaller, more succulent nature and hairy capsule.

E. ephedroides E.Mey. ex Boiss.: Belonging to the large group of terete, wand-like, shrubby succulent euphorbias, *E. ephedroides* is typically a variable species covering a large range from Witputz (Namibia) to Hondeklip Bay in Namaqualand; in the south the 0.5 to 1 m tall plants branching from the base and rebranching distally, are erect, compact, light yellowish-green; in the north they tend to branch more, and are darker greyish-green. The uniting characters are the jointed internodes

and the spreading, fleshy, narrowly oblong or elliptic leaves up to 8 mm long, and the petiolate floral bracts. Var. *imminuta* recognises coastal plants at Alexander Bay which are smaller, cushion-like, with drooping habit. Var. *debilis* describes a miniature form (less than 150 mm tall) which has involucre glands reduced from 5 to 4, and is found on the desert 'sand washes' north of Rosh Pinah.

E. spartaria N.E.Br.: Namibia: according to a review of *E. ephedroides* by Leach & Williamson in *S. Afr. J. Bot.* 56(1), 1990 this species is a yellowish-green, well-branched shrub restricted to the Windhoek and Rehoboth areas. It can be distinguished from *E. ephedroides* by its smaller, spoon-shaped leaves which are only 1.5 mm long, and the unjointed nature at the nodes. According to Bruyns *E. spartaria* is close to the *E. decussata* complex. In the same review by Leach & Williamson two new species were described, one of which has since been made synonymous by Bruyns: ***E. exilis*** Leach (*E. glandularis* Leach & Williamson): occurs from Vanrhynsdorp to Steinkopf in Namaqualand. Another of the terete, narrow-stemmed species, from 300-600 mm tall, branching, the stems not jointed at the nodes. Useful markers are the brown stipular glands at the base of the minute, decussate deciduous leaves in opposite pairs, and the shiny red capsules when in fruit. The inflorescence is terminal, with a single central cyathium and two axillary peduncles raised on either side. The five involucre glands are contiguous and yellowish. Like *E. burmannii* which has prominent stipular glands, this species is heavily browsed. *E. glandularis* described the taller plants which are present in a limited area near Steinkopf. In the same paper Leach described *E. exilis* locating it 'mainly in the Knersvlakte' (around and north of Vanrhynsdorp in the south). He distinguished *E. exilis* from the other new species largely on the grounds of smaller dimension of several features and being densely branched. Since then specimens collected at Nigramoep (north-west of Springbok) and west of Garies have shown the distinguishing characters of the southern plants to be widespread and variable. Bruyns in *Bothalia* 22(1), 1992 shows that the differences are unsubstantiated and he reduces *E. glandularis* to synonymy. He also points out that *E. exilis* is not easily distinguished, except by the experienced collector, from the commoner *E. ephedroides* and members of the *E. decussata* complex, and that the new species is expected to be found between the southern and northern collection points in the future.

E. herrei W.D. & S. [colour p. 99]: Distribution along the lower reaches of the Orange River. A bisexual dwarf under 80 mm in height, branching and re-branching to form chains of short, irregular segments which are angled, especially when young, the angles soften in the older, elongate-globose segments. This unusual plant was collected by Herre at Swartwater in the Richtersveld. It has a narrow taproot and a shortened main stem from which the 'beaded' branchlets arise. At the tip of the terminal segments cyathia of 2 mm diam. cluster, all their parts on a minute scale. There are 5 dark involucre glands, the ovary is glabrous and later the capsule exserts on a pedicel 3 mm long.

E. vaalputsiana Leach: This relatively new species occurs in the radio-active waste disposal area at Gamoep in the western Northern Cape. In 1988 Leach published a review of the *E. juttiae* and *E. gentilis* complex (*S.Afr. J. Bot.* 54(6)) which included the description of the related new species, *E. vaalputsiana*. A dioecious shrublet with tuberous root and densely velvety sub-erect branches; the paired stem tubercles are slightly expanded distally, and ribbed. The capsule, which is almost triangular, and hairy, is far exserted, the pedicel up to 6 mm long. The velvety nature of the stems separates this species from the related *E. gentilis* and *E. juttiae*. It differs further from *E. gentilis* in its slender, taller habit, and from *E. juttiae* (which is monoecious) by possessing 5 involucre glands and a larger, hairy capsule. **E. gentilis** N.E.Br.: Namaqualand and south-western karoo. Subsp. *gentilis* is a small, rounded, much branched shrublet, less than 100 mm tall, found throughout the Knersvlakte. The stems are glaucous, brittle, appearing glabrous, but rough. The branches are opposite or alternate, jointed at origin, the tubercles opposite and decussate, and lightly 3-ribbed; leaves are rudimentary and sessile. The plants are dioecious, but sometimes male plants have bisexual cyathia; 5 oblong-elliptic involucre glands are present. Subsp. *tanquana* Leach is cited from the Loeriesfontein-Williston area in the Northern Cape Province and from the Tanqua, or Ceres Karoo in the south. It is more robust, the stems rounder and often purple, the flattened obsolete tubercles green. *E. gentilis* is closely related to *E. juttiae*. **E. spicata** E.Mey. a little known species of Namaqualand and not mentioned in Leach's review, has the same general habit, but differs in the harsh pubescence of its stems. **E. juttiae** Dinter [colour p. 99] (*E. silicicola*): A monoecious dwarf shrublet up to 150 mm

tall, the apparently much-jointed stems often leaning in a north-west direction. According to Leach the vegetative branches and branchlets are jointed only at their origin. It is a desert plant extending from central Namibia (Gobabis) to Kenhardt in the Northern Cape. Stems are glaucous and rough (as in typical *E. gentilis*), but the leaves are up to 12 mm long, 4 mm wide (in *E. gentilis* leaves are rudimentary). The stem tubercles are prominent, with well marked decurrent ribs – distinguishing it from its two southern allies. Its bisexual cyathium has 4 glands, which also sets it apart from the southern members of this complex.

E. aequoris N.E.Br.: A dwarf, unarmed shrublet up to 200 mm tall, of the Great Karoo from Fraserburg eastwards to Cradock. It has impressive deep-seated tubers which enable survival in its hostile habitat; the aerial, terete stems glabrous and repeatedly forking to form a small clump of close-set branches with internodes from 4–12 mm long. Because the rudimentary deciduous leaves are petiolate it has been suggested that the species may relate to the *E. ephedroides* complex, but in fact this dwarf appears to have a distinct habit of its own. According to Leach *E. aequoris* belongs in the group which includes the *E. juttiae-gentilis* complex discussed above.

E. verruculosa N.E.Br.: Coastal area at Lüderitz Bay and southwards in Namibia. This is another dwarf shrublet, with extensive underground root system from which the aerial stems arise to a height of 75 mm; the tubercles are apparently alternate, not opposite as in the above species. The stems which have the familiar jointed appearance, divide apically into a tuft of branchlets; the tubercles have a warty skin, hence the specific name. The plant is dioecious, the leaves rudimentary, and the involucre gland count is 5, or less often, 4.

The stems have widely spaced, relatively conspicuous tubercles, arranged roughly into 3 ranks

E. gariepina Boiss.: Northern Cape, Namibia and southern Angola. The ancient name of the Orange River was Gariep, meaning 'Great River' along which this species lives. The distribution, synonymy and variation of this species was reviewed by Leach in 1980. It is a dioecious, succulent, rounded shrub, 150–600 mm tall. It is less succulent and with thinner stems than the *E. hamata-peltigera*

complex which lies to the south of its distribution; it has an overall thready appearance. Subsp. *gariepina* occurs in the Fish River (Namibia) and Orange River regions, and extending from Vioolsdrif eastwards to Douglas in the Northern Cape. The separation into subspecies depends on difference of floral characters: in the typical plants the male inflorescence has numerous 'flowering spurs' and branchlets below the cymes of the terminal inflorescence. In female plants the cyathia are usually terminally solitary; the acute styles united into a column for more than half their length. Subsp. *balsamea* (*E. balsamea*, *E. bergerana* and '*bergeriana*', *E. halleri*): The reputed balsam-scented latex was not very noticeable to Leach in any of his collections and yet the group is known to have an unpleasant smell. Subsp. *balsamea* occurs from central Namibia northwards to Moçâmedes in Angola. The male plants have a 3-rayed umbel with subsequent forkings four or five times; in the female the inflorescence is often umbellate, the styles notched or bifid.

E. bruynsii Leach: Steytleville, in the Eastern Cape. A very unusual small species with a turnip-shaped tuber which develops a long underground stem, appearing aboveground as a single or sparingly branched slender stem. Deciduous succulent leaves up to 15 mm long arise from the apex of the conical tubercles which spiral up the stem. Bisexual cyathia are borne on terminal cymes which fork successively as in the northern *E. gariepina*, which, however, is dioecious. *E. bruynsii* apparently has no links with closer neighbours, but resembles the larger shrubby *E. gariepina* in floral character, and in its conical tuberculated stem.

E. hamata (Haw.) Sweet [colour p. 99]: From the Worcester-Robertson Karoo northwards to Lüderitz in Namibia, its range generally to the south of that of *E. gariepina*. *E. hamata* is low growing and densely branched, with clearly marked, well-spaced tubercles in evidence; the name 'hamata', meaning 'hooked', refers to the curved nature of the prominent tubercle which subtends, for a short while, a small sessile leaf. It is unisexual, the cyathia solitary at the branch apex, the involucre surrounded by 3 conspicuous bracts which are usually yellow, in the Knersvlakte these bracts become crimson, adding vivid colour to the quartz patches. It is a handsome species, well worth cultivating, as well as being a useful fodder plant. Marloth listed *E. hamata*, *E. enopla* (if spines were removed), *E. coeru-*

lescens, *E. burmannii*, *E. inermis* and *E. esculenta* as being suitable for fodder. He recorded that farmers were advised to cultivate these but many did not, and it was estimated that during the drought of 1919 the value of stock lost was 16 million pounds sterling. **E. peltigera** E.Mey.: Richtersveld and vicinity of Steinkopf. This species is distinguished from *E. hamata* on the slight grounds of having more prominent tubercles, of being minutely puberulous (downy) on the young growth, while *E. hamata* is glabrous, and the involucre glands in *E. peltigera* are close-set while distant in *E. hamata*. The two species are very similar in habit; the nature of the tubercles is of interest: in *E. hamata* the tubercles are hooked, or recurved, whereas in *E. peltigera* the tubercles are conical, spreading, but not hooked.

E. namuskluftensis Leach: Occurs on white limestone in the Namuskluft in southern Namibia. It is a dwarf, dioecious, non-spiny species affiliated to the *hamata-peltigera* complex. It has tubers and rhizomes, with division into many branch stems which are less than 20 mm in height above soil level, but may lengthen in shade or cultivation. The branches are tuberculate, and about 5 mm thick, the tiny, sessile, caducous leaves about 2 mm long, recurved and attached at the apex of the conical tubercle in true 'hamata' fashion. The involucre glands are only slightly 2-lipped, the outer margin recurved and crenulate. Leach mentions a similarity to *E. wilmaniae* in vegetative character, but it is not affiliated to that species.

E. celata Dyer [colour p. 99] (*E. miscella*): Western Cape: In low-lying areas of Namaqualand from near Vredendal northwards to Komaggas, and Lekkersing in the Richtersveld. The name 'celata' means 'hidden', aptly describing the insignificance of this species which accounts for its late discovery in 1970. The plant is known to have a turnip-like tuber but more commonly produces a dense mass of underground rhizomes with subsidiary tubers (Bruyns in *Bothalia* 22(1), 1992). Only short lengths of the stems (10-20 mm) appear above ground in exposed places. The stem has spiralled tubercles bearing small folded leaves which vary from 1.5-6 mm in length, being shorter in the northern plants unless in a protected position. In both *E. celata* and *E. miscella* (Leach in *S.Afr. J. Bot.* 50(3), 1984) the cyathium is terminal subtended by several bracts from the axils of which more cyathia may develop. In describing *E. miscella* Leach compared it to

E. namuskluftensis but failed to recognise its close resemblance to *E. celata*. A detailed comparison of *E. celata* with the type material described by Leach led to Bruyns's conclusion that only one species was involved. It should be noted that the involucre glands of *E. celata* are entire and not fingered as in *E. wilmaniae* with which there was some earlier confusion.

E. pedemontana Leach: Southern Namaqualand. While not completely succulent, this Lavranos discovery is included here for two reasons: the name 'at the foot of the mountain' will intrigue many, and refers to the great majestic Matsikamma mountain which dominates the plain on which Vanrhynsdorp lies. Secondly, this small dioecious plant with narrow, strongly tuberculate stems, up to 150 mm, shows an interesting affiliation with its neighbour, *E. hamata*, and *E. gariepina* in having prominent, curving stem tubercles. It differs in having herbaceous, caducous leaves up to 30 mm long, 8 mm wide. It is also distinguished from *E. hamata* by its tub-shaped, pubescent cyathium, and the quaint nodular outer margin of the well separated, greenish glands, the last character being closer to the toothed cup formed by the glands of *E. peltigera* in northern Namaqualand.

Geophytes with swollen underground tubers which produce a few herbaceous aerial stems, or, in the more compacted species, a number of deciduous annual leaves

Some species have tuberous roots and underground stems which store water and food, only putting up vegetative growth for essential food-making and cyathia for seed production after a rain. Plants with this habit are called geophytes and among them are several species of *Euphorbia* and *Monadenium*.

E. trichadenia Pax: Angola, Northern Province and Mpumalanga, northern KwaZulu-Natal and Zimbabwe. It is interesting to note that *E. trichadenia* was first found in Angola in 1876, and that *Monadenium angolense* and *M. simplex* (both geophytes) also occur in Angola. Geophytes are not common among the largely eastern monadeniums but this habit has apparently been naturally selected on their journey from the east to the drier west. *E. trichadenia* has a swollen root narrowing into an underground stem from which the thin aerial branches develop to a height of 100 mm. The leaves are nar-

row and acute, the cyathia have leaf-like bracts and the involucre glands have fringed lobes. **E. pseudo-tuberosa** Pax (Transvaal, Botswana and Northern Cape) is very closely allied to *E. trichadenia*, while similar habit is present in *E. gueinzii* Boiss. (Transkei, KwaZulu-Natal, Mpumalanga). It has been suggested that the newly described *E. leistneri* belongs in the *trichadenia*-group, but as it has a succulent, tuberculate, aerial stem it is included in the next section.

In some of the geophytes, the stem seems to be almost absent, the water supply being lodged in the tuberous root; the leaves, produced for a short while each year, appear flat on the ground. This is typical of *E. tuberosa* L. (*E. crispa*) and also of the rather different *E. ecklonii* (Klotzsch & Garcke) Hassl. of the Western Cape, and *E. silenifolia* (Haw.) Sweet which extends from the south-western Cape to Port Alfred. Attention is again focussed on these 'old' species (described at intervals up to several centuries ago) by the description in 1986 of the following species which occurs in a mixed population of geophytes near Tulbagh in the Western Cape: **E. mira** Leach [colour p. 100], from the latin 'mirus' meaning 'remarkable': A dioecious geophyte with a large tuber developing a single shortened neck-stem. The plant is hysteroanthous, i.e. the leaves appear after the flowers. The leaves are very narrow (120 mm × 2 mm) with incurved margins; the inflorescence – a 2-4 rayed umbel – is densely pubescent. What Leach found remarkable was that this species grows with two, perhaps three, closely related species all in the affinity of *E. tuberosa* and *E. silenifolia*, but flowers earlier than they do.

Dwarf to medium sized shrubby succulents, tuberculate with relatively large leaves, in which the involucre have 2 or 3 large green bracts, the peduncles deciduous or, when persistent, not modified into spines

E. bupleurifolia Jacq.: It is partly re-assuring to note that this species with its crown of leaves and 'pine-apple' stem is still apparently widespread in the Eastern Cape and KwaZulu-Natal, as great numbers of fully grown plants are exported from South Africa annually, and this drain must eventually limit its distribution. The geometrically-neat, tuberculated stem is usually unbranched and ideal for pot culture. The solitary cyathia cupped by 2 bracts each develop at the crown of the plant, the peduncles fall away after drying.

*Euphorbia bupleurifolia* in flower*Euphorbia bupleurifolia* with capsules

E. pubiglans N.E.Br.: Extends from Knysna and Uniondale districts to Port Elizabeth in the Eastern Cape. Although similar in habit to *E. bupleurifolia* it can be distinguished by its taller (up to 300 mm) habit, its persistent peduncles and the bracts which surround the cyathia forming a circular plate 25 mm in diameter. As the name suggests, the involucre glands are pubescent.

E. clandestina Jacq. [colour p. 100] Extends widely from west of the lower reaches of the Breede River area to Uniondale, including Montagu and

parts of the Little Karoo. As in the last two species, the erect stem is studded with prominent tubercles, the linear leaves restricted to the crown area. This species is taller (300-600 mm) and easily distinguished from related species by its sessile cyathia which have purple and green bracts and lie at the base of the leaves at the stem apex. **E. cylindrica** W.D. & S. which inhabits the Calvinia district is the same as *E. clandestina* in nearly all respects, but has broader leaves and the cyathia have peduncles up to 10 mm long.

E. tugelensis N.E.Br.: Tugela and Umkomaas river valleys in KwaZulu-Natal. A branching shrub up to 1.5 m tall with linear, sessile leaves up to 120 mm long, crowded at the upper end of the green, sub-cylindric stems. It is closely related to the older species, **E. bubalina** Boiss. but distinguished from it by its linear acute leaves. *E. bubalina* occurs in the coastal region from the Transkei to Bathurst in the Eastern Cape. It is an edge of the forest plant and never found in the open. The slender stems of *E. bubalina* are smoothly tuberculate, the margins of the leaves and the peduncular bracts are often crimson.

E. clava Jacq.: Eastern Cape province, from Humansdorp to King William's Town. The name 'clava' refers to the club shape of the young plants.

*Euphorbia tugelensis*

The species branches with age, growing to a height of over 1 m, branches taper to their junction with the main stem. The conspicuous, linear, slightly folded leaves are up to 130 mm long, spreading or drooping; the solitary green cyathia are borne on peduncles 70-170 mm long which dry and persist for a few years. In common with most species in this group, the involucre glands are entire.

E. monteiri Hook.f. [colour p. 100]: A tropical species which occurs in Angola, Namibia, Botswana, Transvaal and western Zimbabwe. It does not fit easily into this section as it is unique in several ways. After rain, the tuberculate stem produces leafy peduncles from 150-300 mm in length, these eventually wither and persist, curving over the top of the plant. In the cyathium the dark red to blackish-purple glands are fringed with tiny 'fingers'. Subsp. *monteiri* (Namibia, Botswana) has a thickened stem up to 300 mm tall and 100 mm in diameter. Subsp. *brandbergensis* occurs between Tsisab and Konigstein in the Brandberg, Namibia. Its stem is simple or branched and from 1-2 m tall with rounded apex, leafless when dormant but abundant terminal and linear leaves in season on the spirally tuberculate stem. It differs from the typical plants in being taller (the type is 0.5-1 m), it has shorter peduncles, and has 5 yellowish-green glands. Subsp. *ramosa* which occurs in Botswana and the Transvaal has slender branches and an open tuberculate pattern. *E. monteiri* is closely related to *E. wildii* which occurs on the Dyke soils in Zimbabwe and is described under that locality.

E. leistneri Archer: Northern Kaokoveld, Namibia. The description of this species was prompted by the discovery that a plant, collected 22 years earlier and housed in the National Botanical Garden in Pretoria was not, in fact, *E. monteiri*. The resemblance lay in the prominently tubercled stem and apical leaf tufts. Search at the collection site in Namibia proved that the new species was rare. An erect shrub with few to many branches, up to 1 m tall; the leaves, green and obovate, up to 90 mm long are terminal and petiolate, stipules glandular and knob-like. The cymes, usually 4, are also terminal, the cyathia pedunculate (6-25 mm), glands 5, including a rudimentary gland over which the female flower is exerted. The outer margin of the gland is 2-lobed. Flowering in summer (December to January). Archer refers the species to the subgen. *Trichadenia* (Pax) Carter on grounds of its knob-like glandular stipules and large crenulate glands,

and to *E. transvaalensis* Schltr. on inflorescence and leaf similarity. The description lacks line drawings, however, and without them it is difficult to assess these relationships.

E. hallii R.A.Dyer: This distinctive species was discovered by Harry Hall in the valley of the Doring River south-west of Calvinia in the western Northern Cape. The rootstock of this species has several swollen finger-like root tubers. The tubercled greyish-green stem is up to 400 mm in height and 30-40 mm thick; the young apical tubercles bear unusual thin leaf-like bracts up to 100 mm long. The red glands with cream processes, red styles and purple stamens make the species conspicuous when flowering. The photograph of this species by John Trager (*Euph. J.* 2, 1984) captures its charm. It has a very large succulent underground tuber.

Dwarf or shrubby succulents without stem angles, leafy, with many spines which are modified short shoots (they appear in seedlings which have never flowered) or persistent peduncles, or without spines. The involucres have 2 or 3 relatively large green bracts

E. oxystegia Boiss.: Localised on the escarpment



Euphorbia oxystegia

west of Springbok, Namaqualand. An erect, shrubby succulent up to 200 mm tall with a tuberous root, the tubercles not conspicuous, lanceolate leaves tufted apically. Peduncles arise in the axils of the tubercles and are up to 40 mm long. It has relatively few and softer spines than its closer relatives; the spines are probably persistent peduncles.

E. loricata Lam.: From Clanwilliam to Vanrhynsdorp in Namaqualand. A spiny, branching shrub up to 1 m high with linear leaves at the ends of the branches. During Simon van der Stel's journey to Namaqualand in 1685 the party was delayed on the banks of the Olifants River by rain. This provided an opportunity for a closer study of the flora, which led to the discovery of *E. loricata*. Lamarck's name 'loricata' means 'covered with a breast-plate', it was also named 'armata' by Thunberg, and 'hystrix' by Jacquin, all referring to its coat of grey, persistent peduncular spines. The leaves are up to 75 mm long, obtusely ended. **E. eustacei** N.E.Br. [colour p. 100] Western Karoo: From Matjiesfontein to near Calvinia. A cushion-like plant of many crowded branches, a hemisphere covered with the seasonal green leaves which, on falling, reveal the 'hedgehog' armour of white spines.

E. multifolia W.D. & S. [colour p. 100]: Occurs on sandstone veld from Touws River to Calitzdorp in the Western Cape. It forms a green, leafy cushion up to 300 mm in height; its leaves up to 40 mm in length and strongly folded; although similar in general habit, this species lacks the spines of the preceding two species and has very narrow leaves.

Succulents with an erect simple or multi-stemmed habit, covered with prominent tubercles; as in the following groups, the involucre bracts are relatively inconspicuous

E. restituta N.E.Br. [colour p. 100]: From Bitterfontein to Hondeklip Bay in Namaqualand. A multi-stemmed erect small shrublet up to 240 mm or more in height in which the long flowering peduncles (120 mm) curve around the stem. The tubercles are prominent and the main stem usually branches at the base. It is closely related to **E. fasciculata** Thunb. which occurs in the Vanrhynsdorp area. In *E. fasciculata* the main stem (up to 400 mm) does not branch, the stem tubercles have a characteristic central depression and the involucre glands are entire whereas they are toothed in *E. restituta*.

E. schoenlandii Pax [colour p. 100]: From Vanrhynsdorp to Bitterfontein in Namaqualand. Allied to the last two species, this plant forms a robust, spiky column up to 1.3 m tall and 200 mm thick, easily spotted in the rather open veld it occupies. The short tuft of narrow leaves at the apex are soon deciduous. The sharp, woody spines are derived from sterile peduncles which arise from the upper part of the tubercular depression. The flowering peduncles which develop just under the spines fall away after the fruiting season. Both *E. fasciculata* and *E. schoenlandii* are 'North Pole' plants, being heliotropic and turning the apex of the stem toward the sun.

The densely tuberculate main stem is sunken or rising from the ground, with several series of radiating branches, often erect or semi-erect; included here are the small species called 'vingerpol' meaning 'tufts of fingers'. (Outside South Africa this is referred to as the 'caput-medusae group' and yet, E. caput-medusae with its crowded, much-thickened stems narrowing toward the base is not really typical of the 'vingerpols', while E. inermis is.)

A survey of the distribution of this group can only be approximate before a full-scale revision of the genus is undertaken and published, but at present there are about 30 named species some of which are doubtful. The true 'vingerpol' has its tuberculated stem apex devoid of short branches, as is found in E. esculenta, E. pugniformis and others, less typical are those which have no bare crown, the short branches covering the whole apical area, as in E. namibensis. 27 of these species occur in the Eastern Cape and the southern, central and northern karoo, 5 or more in Namaqualand and Namibia, 2 or more in the Transvaal provinces and 1 or more in Botswana. E. davyi occurs in the west and south of Zimbabwe.

Species with mainly an eastern distribution

E. clavarioides Boiss. [colour p. 101]: A unique species with a wide distribution: it has been recorded from Fraserburg eastwards to the Free State, Lesotho, KwaZulu-Natal and the Transvaal. Large and cushion-like, it is not typical of the dwarfed habit present in most members of this group. Some of the finest specimens exist in association with *Aloe polyphylla* on steep northern and eastern slopes of the Lesotho mountains. Here the massive greenish-yellow mounds of closely packed stems

often provide a nursery-climate which encourages this aloe's reluctant germination. The cushion-shape presents the smallest possible surface area to drying winds and is a successful example of xerophytic habit. The sessile cyathia are produced at the tips of the branches, thus leaving the truncated habit undisturbed; the 5 glands of the involucre are greenish-yellow, distant, with short teeth on the outer margin. The specific name refers to the fungus *Clavaria*, some species of which are club-shaped in the manner of the numerous short branches which make up this extraordinary euphorbia.

E. ernestii N.E.Br.: Queenstown district. The main stem, which is largely buried, produces circles of stubby, globular branches, these extending up to 60 mm as they move further from the central branchless area. Sometimes the main stem divides into several heads, when the general appearance of the stubby growths becomes very similar to that of *E. clavarioides*. The involucre glands are rich golden-yellow, with up to 8 teeth along the outer margin. In *E. gathbergensis* N.E.Br. which is common in grassland south of Elliott (Eastern Cape) the main stem remains undivided; the flowers which also have yellow glands, are very fragrant.

E. pugniformis Boiss.: Extends over a wide coastal area from King William's Town westwards to Mossel Bay. A dwarf species, the central area is slightly depressed with 2 or 3 series of short radiating branches up to 30 mm long. It can be confused with *E. woodii*, but has greenish-yellow glands and is a smaller species, its main stem only 50-80 mm thick, compared to a possible 150 mm in *E. woodii*. Closely related is *E. gorgonis* Berger which occurs between the Sundays and Zwartkops rivers in the Eastern Cape, both species occur around Grahamstown. The main stem is 50-100 mm thick, almost completely buried, with 3-5 series of very short branches, 10-25 mm long. It is easily distinguished from its allied species because of its small size and dark red or brown glands (yellow or greenish-yellow in related species). Investigation has shown that *E. gorgonis* maintains its extremely dwarf habit even in cultivation.

E. woodii N.E.Br. [colour p. 101]: It was first collected near Durban in KwaZulu-Natal by Thomas Cooper in 1862. A coastal species, it is common on the sand dunes from Durban southwards to Pondo-land and thrives in the moisture laden winds from the Indian Ocean. The main stem is from 120-150

mm thick, producing 20-40 radiating, ascending branches in two or more series. It is a striking plant, not easily ignored because in addition to the reddened apical tubercles and bright yellow glands, the flowers have a strong odour. It is easily the largest in this eastern group, the second largest being *E. flanaganii* N.E.Br. which grows near Kei Mouth. The flowers of *E. flanaganii* are restricted to the apical area, whereas in *E. woodii* they appear on the branches as well, but in most respects these species are alike. *E. franckisiae* N.E.Br. of the Camperdown district in KwaZulu-Natal is also very similar to *E. woodii*. It lies further inland than the coastal *E. woodii*. *E. franckisiae* var. *zuluensis* refers to plants in northern KwaZulu-Natal in which the stem apex contracts, or divides, forming a cluster of small heads.

E. esculenta Marloth [colour p. 101]: From Uitenhage northwards to Jansenville, Graaff-Reinet and Somerset East. The buried main stem produces numerous almost upright 'fingers' leaving a very small branchless area, the whole 'head' measuring up to 0.5 m. This is the true 'vingerpol' species; its name 'esculenta' means edible, and it is one of the very nutritious plants which Marloth encouraged farmers to use for their stock during drought. When in bloom, this beautiful species gives off a delicate sweet scent; the white woolly bracteoles densely fill the involucre of the terminal, clustered cyathia. *E. fortuita* which occurs in the Western Cape is closely related.

E. inermis Mill.: From the Fish River valley to the Uitenhage district. This species is very closely related to *E. esculenta*. In both species, the root system can be distinguished from the swollen stem, unlike others in this group where the two organs are compacted. As in *E. esculenta*, the male flowers are interspersed with numerous woolly-white bracteoles, making a dazzling display when the plant flowers. *E. inermis* can be distinguished by its shorter peduncles (3-4 mm) which are sometimes persistent, and by its styles which are almost fully joined into a slender column. In *E. esculenta* the peduncles are deciduous and the styles joined for only half their length. The name 'inermis' meaning 'unarmed' is appropriate - cattle, buck and porcupines feed readily on this species. There is a form of this species which occurs on the Carlisle Bridge flats (only several kilometres away from the typical form) which White et al. recognised as var. *huttoniae* on the grounds that the latter lacked the white

woolly bracteoles which are conspicuous in the typical variety (and in *E. esculenta*).

E. brevirama N.E.Br.: Klipplaat in the Jansenville district in the Eastern Cape. An insufficiently known species of the 'vingerpol' group described as having very short branches (8 mm long) and small, green, circular involucre glands with a cup-like cavity and the outer margin entire.

E. albiglobosa Leach: Eastern Cape: Springbok Flats, east of Steytlerville, and west of Kirkwood. A dwarf succulent, but certainly not a herb as stated in Leach's description. It is typical of this group, with a subglobose body, tuberculate, central apical area with relatively few spreading branches up to 75 mm long. The peduncles up to 20 mm, becoming hard but not spiny, and 'subpersistent', bearing a solitary bisexual cyathium. The glands are well separated, round, fleshy, brown turning green. The male flowers are prominently exerted, and, surprisingly, bear snow-white pollen. Also unusual is the peduncle, jointed near its apex, and the pubescent ovary. Probably related to *E. albertensis* and *E. brevirama*, but is a smaller plant.

Species with western, central and northern distribution

E. fortuita W.D. & S.: Ladismith district in the Little Karoo. This species resembles *E. esculenta* of the eastern karoo but is much smaller and its tuberous root and main stem form one body. It possesses dark purple glands which distinguish it from its Oudtshoorn ally, *E. colliculina* W.D. & S. which has bright red glands. The latter's name refers to its habitat on the hills to the north of the town. *E. colliculina* differs further from the Ladismith species in having more slender branch stems (4-7 mm thick) and the peduncles are persistent.

E. muirii N.E.Br.: Extends from Mossel Bay westwards. It is a coastal species, often found well buried in the sand dunes. The aerial branches usually form secondary rosettes, producing a spreading habit. Marloth collected a closely related species, *E. marlothiana* N.E.Br. [colour p. 101] on the Cape Flats which also has its main stem completely buried, an advantage in areas where sand is wind-shifted: in both species the aerial stems tend to re-branch at their apices; they seem to be distinguished on rather slender differences of floral char-

acters, one of these being that in *E. muirii* the involucre are pubescent, whereas in *E. marlothii* they are glabrous. In *Euphorbia* taxonomy (and indeed elsewhere) there is simply no substitution for line drawings of the floral parts (after the style of Leach and Bruyns); without them comparisons and relationships between closely related species cannot be drawn.

E. caput-medusae L. [colour p. 101]: This species grows in robust fashion on the slopes of Lion's Head above Table Bay in the Cape Peninsula. Unlike the last two species, its stem appears partly above the ground, and is densely covered with many crowded branches up to 300 mm long; the tubercles on the branch stems are 6-8 mm in length. The soon deciduous small leaves are 3-5 mm long. The old peduncles are short, rarely up to 10 mm. The glands of the 'Head of the Medusa' - so named by Linnaeus in 1753 - have a contrast of colour: the base of the gland is green, while the tiny deeply divided processes form a white fringe; the glands and the ovary are glabrous. It would be an advantage for designer jewellers to study the cyathia of euphorbias: so many of them are exquisite both in form and colour; *The Euphorbia Journal* (Strawberry Press) does justice to this aspect in its series 'Identification Guide for the 'medusoid' Euphorbias'. Because of its situation at Cape Town *E. caput-medusae* is one of the best known of the South African euphorbias.

E. tuberculata Jacq. [colour p. 102]: A well-known species which extends from the Malmesbury district northwards into Namaqualand; it occurs in sandy soils from Clanwilliam to Botterkloof and in the western coastal sandveld to Alexander Bay. It has the familiar habit of the tufted euphorbias but on a large scale, and like most of them is attractive in bloom, with velvety-green glands which end in tiny cream-coloured curved processes. The main stem is largely buried, producing a robust rosette of erect or decumbent branches which thicken to about 40 mm and may reach a height of 750 mm; the deciduous leaves are from 5-40 mm long. The ovary is densely pubescent; the peduncles lengthen up to 50 mm as the fruits ripen, then harden and persist. On the sand flats near Klaver the stems are often covered with a white crust, a deposition of salts from the soil forming a reflective layer which must certainly protect the plant from the sun's heat. In 1929 Herre found a similar but smaller species in the Richtersveld

which was later described as *E. confluens* Nel. The green, spreading involucre glands of this species have an outer white fringe of 4-6 narrow fingers branched at their tips.

E. ramigians N.E.Br. [colour p. 102]: On the lower reaches of the Orange River east of Alexander Bay near Beauvallon and probably exists on the Namibian side as well. A dwarf species about which little has been written, except that the cyathia are solitary at the ends of the short tuberculate branches which must arise from a sunken central body. The flowers have much the same construction as those of *E. tuberculata*, with fingered glands, the yellow processes forked at their tips.

According to Bruyns, the 'caput-medusae' complex starts with *E. marlothiana* on the Cape Flats, (probably further east in the form of *E. muiirii*) and continues to the luxuriant *E. caput-medusae* on the well-watered slopes of Signal Hill at Cape Town, and northwards in the dry regions to *E. tuberculata*, and further north to *E. ramigians* - all having the same basic floral structure.

In the following species the swollen stem tends to reveal itself aboveground

E. crassipes Marloth: Beaufort West district. A dwarf succulent; the globose-cylindric main stem, half-buried, has a rosette of short 'finger' branches which have persistent peduncles up to 10 mm long. The main stem has a well defined central branchless area. It is close to *E. fusca*, but has a flattened, not furrowed, apex, and the involucre glands are green, not brown as in *E. fusca*.

E. albertensis N.E.Br.: Near Prince Albert in the Great Karoo. A dwarf species related to *E. crassipes* but does not have a central branchless area; numerous stubby branches develop from all over the upper part of the main stem. The inflorescence is most unusual: the peduncle (12-25 mm) has a whorl of bracts at its apex, from which a single, short (2 mm) cyme branch arises at an angle, bearing a single cyathium. The peduncles are persistent.

E. decepta N.E.Br.: From Beaufort West to Jansenville in the Great Karoo. A dwarf species up to 80 mm tall, the globose main stem partly buried, dull greyish-green above, the exposed part covered with stubby, finger-like branches 10-35 mm long, carrying persistent peduncles 5-15 mm long. Un-

like the related *E. fusca* and *E. arida* it has a glabrous ovary. Glands are distant, dark green and with minute teeth. Closely related is *E. astrophora* Marx (so-named because from above it appears star-like) from north of Klipplaat in the Eastern Cape. It is smaller than *E. decepta* with slightly depressed globose main stem about 40 mm tall and 50 mm wide, the branches 10-20 mm covered with persistent peduncles up to 18 mm long. In *E. decepta* these peduncles are the blunt dry remains of fertile peduncles, whereas the Klipplaat species has blunt and sharp (sterile) peduncles. The glands are separate, concave, the radiating teeth more prominent than in *E. decepta*.

E. arida N.E.Br.: Great Karoo: near De Aar. The cylindric main stem stands 50 mm or more above ground and is about 50 mm thick, covered to its apex with many short erect spineless branches bearing persistent peduncles, these branches eventually shrivel away at the base of the exposed stem. Plants subsequently collected by Dyer in the southern Free State seem to agree largely with the description of the type. It is difficult to say more: the central and eastern *E. breviflora-decepta-arida-astrophora* complex should be thoroughly investigated in the field and sound diagnostic characters drawn.

E. fusca Marloth: Widely dispersed in the Great Karoo, especially Britstown, and northwards into Botswana and Namibia. It is similar to the preceding five species but is generally much larger with a wide distribution and easily recognised by the furrow which cleaves the apex of the main stem - this feature is absent in the related species. The large globose body is up to 200 mm thick, and has short hard finger-like branches with persistent peduncles radiating outwards from all points except the apex. The name 'fusca' which means dark brown, refers to the unusual colour of the involucre glands. ***E. inornata*** N.E.Br. from the Kimberley and Hope-town districts in the Northern Cape is similar but smaller and its glands are green.

E. suppressa Marx: Prince Albert and Klaarstroom, both areas lying north of the Swartberg Range and in the Great Karoo. Marx calls this species "the smallest of all miniature medusoid euphorbias". In fact, the really small brownish-green specimens are near Klaarstroom; just west of this locality larger plants form a cylindric body 90 mm aboveground. The plant body is subglobose to sub-

cylindric, with a narrow taproot, the stem 30-60 mm across, flat above, tuberculate, with many, very short branchlets about 7 mm long which leave a clear apical area; the leaves are rudimentary. Inflorescence axillary near the branch apex, peduncles 13 mm, subsistent but not spiny, with 5 bracts and a single cyathium, usually bisexual. Glands 5, distant, dark green, with several obscure teeth on outer margin. Male flowers exerted with hairy pedicels, the capsule glabrous and proportionally large for so small a plant. In his discussion, Marx rejects a close similarity to *E. albertensis*, but admits to the similarity of a second little known species, *E. brevirama*, adding that the 'saucer' glands differ from the cup-like glands of *E. brevirama*. The new species is closest to *E. arida* which has longer branchlets and a pilose ovary.

E. gamkensis Marx: Gamka River valley in vicinity of Calitzdorp in the Little Karoo. A dwarf plant with a globose body 70-90 mm thick, branches 18 mm long except at the tuberculate, slightly depressed apex, leaves rudimentary. Cyathia solitary at branch tips, mostly bisexual, peduncles 7-11 mm with a few bracts, involucre very shallow, the 5 glands distant, green, subcrenate on the outer margin. The male flowers have hairy pedicels, the capsule sparsely hairy.

Marx states that the illustration of these plants by White, Dyer & Sloane (1941) as intermediates between *E. crassipes* and *E. fusca* caused confusion. *E. fusca* is distinguished by its brown fingered glands. *E. gamkensis* differs from *E. crassipes* (of Beaufort West) in having a pedicellate hairy ovary, crenate glands and very shallow involucre.

The two new 'vingerpols' described recently by Marx (*Cact. & Succ. J. (US)* 71(1), 1999) along with five relatives, some of doubtful origin, highlights the need for revision of this group.

E. pentops W.D. & S.: Namaqualand. An attractive dwarf species with partly emergent main stem. Its specific name 'five eyes' refers to the green spot at the base of each of the distinctive 5 glands; the outer margin of the gland light-coloured, broad and flatly fingered. The flowers are held well above the branches on fairly long peduncles which are persistent.

E. ballola N.E.Br.: Found by Pearson in 1908-09 in the Great Karas Mountains of Namibia. An insufficiently known species which is distinguished from its relatives by the stem tubercles, which are form-

ed from the persistent bases of the old branches; these cover the entire crown of the main stem. The involucre glands are velvety-brown and the centre of the cyathium is filled with white, woolly hairs, the peduncles 2-6 mm long are persistent.

E. melanohydrata Nel: Richtersveld, near the mouth of the Orange River. A subglobose dwarf which has very short, stubby branches, developing all over the main stem; the cyathia are 2 or 3 in cymes; the peduncles are up to 13 mm, rarely simple, dividing into 2 or 3 cyme branches and are persistent. The glands are separate, green, with 3 narrow processes on the outer margin.

E. namibensis Marloth: First collected by Marloth near Tschaukaib, the species is fairly frequent in parts of the Namib coastal desert in Namibia. It has a swollen, rounded, partly buried stem, from which short branches develop at all angles. In the growing period each branch bears a cluster of narrow, folded leaves. The glands are green with up to 5 processes on the outer margin. The peduncles of the solitary cyathia are persistent and the capsules are glabrous.

E. friedrichiae Dinter [colour p. 102]: Warmbad and northwards, in Namibia. The main stem stands 150-200 mm above ground, and is up to 100 mm thick. The branch tips bear linear leaves after the manner of *E. namibensis*, but differ in that they rebranch into secondary branchlets. The glands are brownish-green with a fingered outer margin. The capsule is covered with soft, bristle-like hairs, unlike the glabrous capsules of *E. namibensis*. Noted as having an evil-smelling latex, it is apparently unpalatable to grazing animals.

E. namaquensis N.E.Br.: On both sides of the Orange River in the arid north-western region. A peculiar spineless dwarf up to 150 mm in height with an irregular outline due to the presence of many short branches and some very long ones tapering to slender points which later wither; even the peduncles have very irregular lengths; overall the plant has a ragged appearance. The habit of *E. multiramosa* Nel from the Richtersveld is apparently indistinguishable from that of *E. namaquensis*, which indicates the need for further investigation of these species.

E. multiceps Berger [colour p. 102]: Discovered by Marloth in 1904 near Matjiesfontein in the

Western Cape, it has a wide distribution from the Little Karoo to Steinkopf in Namaqualand. So many of the South African dwarf succulent euphorbias share the habit of a low thickened main stem with short tuberculate branches that it is a pleasing change to encounter *E. multiceps* ('many heads') which has elevated itself into a novel cone shape, although the elevated habit is not a constant feature. The aerial stem stands at maturity at about 300 mm (sometimes taller), and is densely covered with branches which shorten in length towards the apex. Most peculiar are its spines, which develop from the main stem and the branches; these suggest that *E. multiceps* is a spiny species, but other features show its affinity with the non-spiny species such as *E. namibensis*.

The main stem is usually difficult to differentiate from the branch stems; plants may be cushion-shaped

E. braunsii N.E.Br.: Extends from Prince Albert northwards through the Great Karoo to Prieska and into Namibia. The main stem develops a large number of lateral branches 20-30 mm thick, forming a compact cushion 'spiked' with persistent peduncles. It is difficult (or impossible) to distinguish the main stem from the laterals. The species grows to 150 mm in height and 100-250 mm in diameter. **E. rudis** N.E.Br. [colour p. 102] which occurs north of the Orange River in Namibia is smaller but has a very similar habit in which the lateral branches and the main stem all reach much the same height in the older plant. It is found in extremely arid conditions where it embeds itself deeply in the ground, while in cultivation it tends to elongate. The gradation between the typical forms of the two species requires further field investigation as it is most probable that only one species is involved. Both were described by N.E. Brown in 1915.

E. bergii W.D. & S.: Free State and Northern Cape. The main stem of *E. bergii* elongates without forming the thick body characteristic of the 'vingerpols', and there is uniform growth of branches and main stem, forming a somewhat flattened mound of stems which are narrow and densely tuberculate. In addition the laterals rebranch two or three times. The cyathia are solitary and the short peduncles persistent; the glands are distant, with 2-4 processes on the outer margin.

Main stem much branched near the apex; peduncles from 25 to 70 mm long

E. filiflora Marloth: (*E. nelii*): Northern Namaqualand. The erect main stem (up to 300 mm tall) has lateral branches along its upper length; the stems are spineless but carry the persistent peduncles. Clusters of linear leaves appear at all stem apices in season, and the long peduncles (50-75 mm) produced from the axils of the tubercles are persistent. The involucral glands are green, the outer rim pale and fingered. Apparently more compact and cushion-like is the closely related, freely branched **E. brakdamensis** N.E.Br. [colour p. 102] collected at Brakdam and Ratelspoort (not far from the locality of *E. filiflora*) which also has linear, channelled leaves and persistent peduncles up to 55 mm long.

E. versicolores Williamson: Central Richtersveld. A dwarf species about 150 mm tall, the obconical stem mainly underground. The branch stems up to 100 mm long are tuberculate with curved, woody, persistent peduncles up to 35 mm. The 5 glands are green with 2-3 deeply divided fingers. The specific name refers to the colour changes of these glands from green to yellow and shades of dark red. According to Williamson its closest relative is *E. filiflora*.

Several species with sunken main stem and radiating finger-like branches inhabit the Transvaal and Botswana

E. davyi N.E.Br. [colour p. 103]: Transvaal: north of Pretoria, Marico and Waterberg districts; Botswana; Zimbabwe: in the western region and south of Gwanda. A dwarf succulent, the main stem mostly buried and bearing a lax rosette of branches around the central area; conspicuously leafy during the summer rains, the leaves up to 28 mm long. The vingerpol euphorbias all have deciduous (usually linear) leaves but in very few are these longer than 20 mm – the exceptions are: *E. tuberculata* (up to 40 mm), *E. namibensis* (up to 37 mm), *E. friedrichiae* (up to 40 mm), and *E. filiflora* (20-30 mm). The cyathia of *E. davyi* are solitary, mature peduncles are 4-10 mm long, deciduous or persistent for a season. Very similar in habit is **E. maleolens** Phill. with shorter leaves and a capsule marked with vertical reddish bands; this species grows near Bandelierkop (The Northern Province) and in the Lydenburg district (Mpumalanga). Both species have long-

fingered glands; it is very likely that only one species is involved here.

E. duseimata R.A.Dyer: Discovered in Botswana in 1931, also recorded in the Northern Cape and and possibly as far south as Cradock. The long carrot-like root is topped by several underground stems which produce scanty thin branches up to 60 mm long at ground level. The leaves are rudimentary, peduncles 5-8 mm and deciduous, the glands shortly toothed on the outer margin, greenish-white with pale reddish spots. An unattractive but interesting species which is not clearly delimited.

(Conclusion of medusoid or vingerpol species)

Dwarf succulents in which the inner lip of the involucre gland is drawn over the cavity at the base of the outer lip, which has conspicuous finger-like outgrowths. Stems are compact, beaded or closely segmented, mat or cushion-like, mostly rhizomatous

E. tridentata Lam. [colour p. 103]: Recorded from Riversdale in the Western Cape to Grahamstown in the Eastern Cape. The plant possesses underground rhizomes and a spreading aerial system of slender branches which die back in the wild and may disappear completely during a long dry season. Cyathia are solitary and shortly pedunculate, with 5 glands which have 3-4 fingers each. Its name refers to the conspicuous fingers on the margin of the lower lip of the involucre gland. The species was described by Lamarck in 1786.

E. ornithopus Jacq.: Its distribution is quite close to that of *E. tridentata* in the Albany and Cradock areas. The name 'ornithopus' (bird's foot) is an apt description of the claw-like extensions of the glands. The rhizomes and aerial stems are very similar to those of the closely related *E. tridentata*, the tuberculate stem segments varying from 10-30 mm long. In the latter the cyathia are usually solitary, with 5 glands, whereas in *E. ornithopus* the cyathia usually have 4 glands and are solitary or arranged in cymes of 2-5, the peduncles from 12-100 mm long. Distinction between the two species is not substantial. Another 'old' species, it was described by Jacquin in 1809.

E. globosa (Haw.) Sims: Uitenhage and Port Elizabeth districts. This quaint, segmented species is a

great favourite with collectors, and yet reveals its true globular character best in the wild at the foot of dry karoid scrub. In nature, the globular stem segments form mats; the older segments are drawn down into the ground (this contractile habit is carried to an extreme in *E. planiceps* of the same group). The flowering branches may lengthen up to 60 mm, and the cyathia, with typical 'finger' glands, are borne on long or short peduncles.

E. wilmaniae Marloth [colour p. 103]: Griqualand West in the North West Province. Almost the entire plant body is underground, often wedged among rocks; the aerial branches are scarcely 30 mm high. The small leaves are soon shed, leaving grey scars at the tubercle tips. The underground stems are plentiful and similar to the rhizomatous growth of *E. namuskluftensis*. The bisexual cyathia are single at the stem apex, sessile, the 5 glands white with 3 narrow fingers each, pitted within; much smaller than the striking cyathia in *E. tridentata*. This quaint plant survives best in its own habitat.

E. planiceps W.D. & S.: Griqualand West in the North West Province. The thickened underground stem produces a great number of branches which re-divide, forming a dense congested mat (up to 300 mm in diameter) which appears flat on the soil surface. This 'flat head' is due to the continual contraction of the branches downwards, a feature which controls water loss in the arid areas in which it lives. Unlike the related species here it does not develop rhizomes. The flowers are typical of the group in that the glands are two-lipped, the outer lip with 3-4 fingers about 3 mm long.

E. polycephala Marloth [colour p. 103]: Cradock and Pearston districts in the Eastern Cape. A further example of compact, truncated habit, but in this case the branches are 10-20 mm thick whereas in *E. planiceps* these are 5 mm thick. There is a thickened tuberous root but no rhizomes. In the description of her family farm, Cranemere, near Graaff-Reinet, Eve Palmer described the 'Mountain Vingerpol' in the following words: "The plants made great mounds of solid flesh, some six feet across, nearly two and a half feet high". This description referred to a colony of *E. polycephala* on a high hill, Rooikop, which catches the moist south-east wind. Unfortunately this colony has (except for one fenced plant) disappeared. The author monitored this colony from 1983 to 1985 and found that the decline of the Cranemere population was

due to several successive droughts coupled with destructive invasion by burrowing animals and subsequent desiccation. At Rooikop the plants, on hard rocky soil, pushed upward and made mounds which provided a nursery for certain bulbs which were dug out by burrowing creatures. If the canopy of the mound is broken into, the plant has no means of repair, and slowly dies (Court in *Euph. J.* 5, 1988). In valleys where the soil is deeper the segmented stems are drawn into the soil and the plant presents a flat surface. Cyathia are solitary or in cymes at the apex of the densely packed stems, and the glands are fingered.



Cyathia of *Euphorbia polycephala* on terminal stem segments

Unisexual dwarfs in which the stems are distinctly ribbed or angled and peduncles, if persistent, do not form spines

In the following the main stem is mostly above-ground and is typically unbranched



The author with a large specimen of *Euphorbia polycephala*



Euphorbia polycephala, a juvenile plant about 0.5 m in diameter

E. obesa Hook.f. [colour p. 103]: A distinct, rare and beautiful dwarf species localised in the Graaff-Reinet district in the Eastern Cape. In 1940 Dyer recorded the protection given it by some farmers; this has been increased since 1994 by the efforts of Daphne and Albert Pritchard (*Euph. Study Group*) of Warrington, England, by means of fencing and monitoring. The species is unisexual, spineless, 8(-10) shallow-angled or ribbed, transversely striated in purplish-brown to grey; its shape hemispherical, elongating with age. Solitary cymes arise from single 'flowering eyes' along the margin of the rib near the apex of the plant, peduncles not persistent. Very similar plants lie to the south-west in the Willowmore district; their only substantial taxonomic difference being the possession of multiple peduncles at a single flowering eye, other differences being simply variable ones of dimension. The decision of White et al. to raise these to the status of *E. symmetrica* was never a satisfactory move. The south-western form is now known as *E. obesa* subsp. *symmetrica*.

E. meloformis Aiton [colour p. 104]: Eastern Cape. An 'old' species, described in the troublous year of the French Revolution, and its future, likewise, has been beset with argument and emotion, if not, luckily, with decapitation. Unlike the smooth, genteel *E. obesa*, this is the rough country cousin, with deep angles and untidy array of persistent peduncles. Its distribution lies in and near Grahamstown, in Uitenhage and Coega areas (coastal), and,

according to Marx, outliers near Peddie and Alice where huge specimens occur, in width – up to 150 mm broad – rather than in height (up to 120 mm), but these measurements are exceptional. Having lived and worked botanically in Grahamstown for 25 years, the writer has not experienced a problem in delimiting this species from the much taller *E. valida* N.E.Br. which lies inland in a band from Steytlerville to Somerset East and Bedford, its best known locality being the Dikkop Flats in the Carlisle Bridge area. These tall, robust, unisexual plants reach dimensions of over 300 mm tall, more than 120 mm thick, with ragged persistent peduncles. They are well separated from the small, withdrawn plants near Grahamstown by the Hell's Poort range of hills. However, again substantial discontinuous variation is not encountered and one has to support the move to reduce the rank of *E. valida* to one of *E. meloformis* subsp. *valida* [colour p. 104].

In the following 5 species the main stem is typically below ground level, the branch stems aboveground or partly so; the peduncles are usually deciduous

E. susannae Marloth [colour p. 104]: Western Cape: Ladismith district in the Little Karoo. Cultivated plants look quite unlike plants in the veld which are cryptic. The 12- to 16-angled main stem produces a host of branches, all of which (including the main stem) only show their apices on the surface of the soil. So conservative of water is this delightful species that its leaves are reduced to short bristles on the young stems, and its prominently tubercled stems are always hidden in its natural state. Growth is apical and upward of course, but the stems are dragged downwards by contractile action, probably seated in the roots.

E. hypogaea Marloth: Fraserburg to Victoria West in the Northern Cape. It was discovered in 1909 by Marloth on the Nuweveld Mountains near Beaufort West. In *Succulent Euphorbieae* (White, Dyer & Sloane) this species was placed with the *medusoid* or *vingerpol* species, a series in which most of the species have the same general appearance, and in which this very dwarf species stood out as being conspicuously different. As its name suggests, it remains largely underground, with root, stem and primary branches buried. Several thickened, club-shaped branches, heavily tubercled, appear above the ground to a height of up to 50 mm. Its concealed nature is advantageous in an area where ground heat is intense during summer.

E. pseudoglobosa Marloth [colour p. 104] (*E. juglans*): Little Karoo, and from Touws River to Barrydale, in the Western Cape. It is present on quartz patches in the Ladismith district. The tuberous root and main stem form one underground body, the latter producing clusters of 5- to 8 -angled globular to cylindric narrow-necked branches. These are usually buried for half or more of their length – probably due to the contractile action mentioned under the last species. In very exposed places only the tips of the secondary stems appear at soil level.

E. tubiglans Marloth ex R.A.Dyer: From the Little Karoo in the Western Cape, and from Jansenville to Uitenhage in the Eastern Cape. The aerial branch stems are 5- to 6-angled, up to 80 mm tall, forming a cluster above a turnip-shaped underground tuberous organ which hardens and cracks with age. The stem angles are somewhat obtuse, tubercles very small, and unusual is the abrupt constriction at the base of the stem into a very narrow neck which joins the branch stem to the tuber. In the male plant peduncles are over 2 mm long; glands are distant and fold inwards laterally, forming a tube (hence the specific name) and are red, contrasting with the white involucre lobes. ***E. jansenvillensis*** Nel was described from material from the Eastern Cape. The aerial stems look similar to those of the last species but are up to 160 mm; they re-branch or segment, and the reduced underground stem produces rhizomes. The involucre glands are distant, erect, deltoid and yellowish-green. This species is similar to, if not the same as, *E. tubiglans*.

Unisexual dwarf or shrubby species with stems distinctly angled, some or all of the peduncles persistent and becoming hard spines

E. cumulata R.A.Dyer: Fish River valley in Albany and Peddie districts in the Eastern Cape. A small species up to 200 mm tall which forms dense clumps of erect 7- to 9-angled spiny stems; these develop separately from underground rhizomes – a feature unknown among related species. Cyathia are solitary, pedunculate to 5 mm and clustered at the apex of the stems.

E. mammillaris L.: Oudtshoorn and Riversdale districts in the Western Cape. The oldest-named species of the 'corn-cob' euphorbias, so-called because in some specimens the stem tubercles are marked off horizontally like mealies on a cob. In

E. mammillaris the main stem produces a cluster of branch stems which are many-angled, 40-60 mm thick and up to 200 mm tall. Grey spreading spines are derived from the sterile peduncles and occur in bands due to the shedding of the fertile peduncles. When fruiting the brownish globular capsules cover the stem tops in the female plants. *E. nesemannii* R.A.Dyer of the Robertson-Worcester and Swellendam areas may be distinguished from *E. mammillaris* by its tuberous underground body and the absence of tubercles on the older branches; but in general the habit is that of *E. mammillaris*; length of stem cannot be used as a separating feature, exposed stems are shorter, in the shade stems are longer. *E. fimbriata* Scop. is most likely the eastern expression of *E. mammillaris*; it occurs from Port Elizabeth to Albany and northwards to Somerset East; the region it occurs in has dense bush cover, quite unlike the open expanses of the Little Karoo, and this must effect its habit. It is a variable, true 'corn-cob' species which at times strongly resembles *E. mammillaris*, particularly when growing in exposed places. It often grows in the shade, becoming enmeshed with the stems and roots of taller shrubs, and adopts a sinuous habit in which the peduncular spines are all but absent. In general, the stems are narrower than those of *E. mammillaris*, the spines and peduncles are longer and the involucres larger. Dried material of *E. submammillaris* Berger which is of unknown origin and distribution appears to have some affinity with the 'corn-cob' species.

E. pulvinata Marloth: It is possible that this wide-spread species migrated from the Soutpansberg in the Transvaal along the Drakensberg southwards to its type locality near Queenstown. It covers a wide eastern range which includes Swaziland and the eastern Free State. This spiny cushion-like species is popular among collectors because of its ability to withstand cold and wet conditions. The crowded 7-angled branches grow from 150 to 300 mm tall, forming neat rock-like mounds measuring 1.5 m or more in diameter and in its northern range the angle count increases to 9. The deciduous leaves are described as being rudimentary in dry areas but up to 30 mm long in the moister climates of KwaZulu-Natal and Mpumalanga. It is a montane species, on the Katberg Pass north of Fort Beaufort in the Eastern Cape plants have been found at 1840 m, tolerating mist and rain. On the mountains it is a magnificent species, forming boulder-like shapes and filling in the gaps between rocks. *E. ferox* Marloth

extends from the western Great Karoo to Graaff-Reinet in the Eastern Cape, and southwards to Steytleville. The typical *E. ferox* plants are fiercely armed with stout spines up to 30 mm long all along the 9- to 12-angled stems which form smaller and less regular clumps up to 150 mm high. The spines are brown, becoming grey. It is known locally as 'voetangel' because the spines sometimes lodge in the hooves of stock. This species is edible and provides useful drought fodder if the farmer first burns off the steel-like spines.

E. aggregata Berger: This species is the oldest of the three multi-stemmed species and extends from Prince Albert to the eastern karoo and Fauresmith in the Free State. It has very similar habit to that of *E. pulvinata*, but on a smaller scale. It is also close to *E. ferox* Marloth. It is set aside from the other two here because it is a much smaller plant, 50 to 75 mm. tall. The leaves are rudimentary and the spines, 6-8 mm long, are reddish-purple when young. It could be said that *E. pulvinata* is montane with larger leaves, while *E. aggregata* and *E. ferox* are of the plain, with rudimentary leaves, but this does not solve the problem of intermediate forms.

E. heptagona L.: The name of this Linnean species is now applied to the large erect-stemmed, metre-high, freely branched plants which occur on the sides of kloofs and in the mountains of Ladismith and Oudtshoorn in the Little Karoo and Prince Albert to the north of the Swartberg. This shrub grows from 600 mm to 1.3 m in height and is not cushion-like. No less than 4 varieties (outside the typical) have been described on the strength of dentate angles, subsessile cyathia, cyme arrangement and greenish (not brown) spines; all of these could encompass the variability of a species which is, itself, very closely aligned with *E. atrispina* and *E. enopla*. Described in 1828, *E. heptagona* is the oldest name for three spiny shrubs which are difficult, if not impossible, to distinguish, while the varieties of *E. heptagona* are taxonomic nonsense. The specific names apply to distribution areas and are given here. *E. atrispina* N.E.Br.: A 'cushion' euphorbia which extends from the southern limits of the Great Karoo to the Little Karoo. The name refers to its black spines which are typical although a green-spined variety has been recorded from the Montagu district. The 6- to 9-angled branches are about 20 mm thick and rounded, without prominent angles. Apart from the fact that the species is dwarf (70-200 mm high), no important features distinguish

it from its close allies, *E. heptagona* and *E. enopla* which have a larger, bushy habit. *E. enopla* Boiss. [colour p. 104] has an eastern distribution from Willowmore towards Jansenville and Graaff-Reinet. It forms a spiny rounded bush (0.3-1 m high), glaucous green, but light green and purplish at the stem tips, the spines red, then blackish and finally grey. The cyathia are pedunculate, bearing 4-6 small dark red bracts.

E. pentagona Haw. [colour p. 104]: Common in the karoid scrub from Uitenhage to the Kei River in the Eastern Cape. It is the tallest of the species which have peduncular spines, attaining heights of up to 3 m. Unlike its relatives which branch from the base, it often exhibits a thick central stem which branches prolifically a short distance above the ground. The name indicates 5 angles but the older stems often deviate from this number. Its high, thorny surface provides a favourite sunny spot for climbers such as *Fockea edulis* and *Kedostriis nana* which are often found in association with it. At Pluto's Vale and Ecce Pass north-east of Grahamstown this species forms a major component of the dense bush vegetation.

E. cereiformis L.: A Linnaean species of unknown origin; the word 'cereus' means a wax candle, to which the erect stems are likened. There is no authenticated record of where it was found in the wild. Its name persists, however, in collections.

E. anoplia Stapf. is another doubtful species, this time more intriguing, because it is said to have been collected in the Uniondale district, and is described as being a spineless, unisexual, columnar plant up to 180 mm tall, the main stem 7- to 9-angled and up to 50 mm thick, with several branches from the base. Being spineless immediately eliminates it from the species described here. It would be of great interest to uncover its history.

E. inconstantia R.A.Dyer: This name was applied to a variable euphorbia occurring near Grahamstown by R.A.Dyer in 1931. It is a spiny shrub up to 1.5 m in height, the thick branches having a diameter of 40-70 mm. It shows features of both *E. pentagona* and *E. polygona*, and is always in association with one or both of these species. It is most certainly a hybrid between these two species and was observed by the writer on her farm, Trapalanda, occurring as a single specimen between plants of *E. polygona* and those of *E. pentagona*. It could very well be the answer to the origin of *E. cereiformis*.

E. polygona Haw. [colour p. 105]: A striking, many-angled species which forms clusters of branches of uneven heights up to 1 m tall and 70-100 mm thick on the hillsides from Ladismith in the Little Karoo to the Albany district. Each plant is many-stemmed and is characterised by nearly always having several dead stems, the grey casts of which drape themselves over the rocks among which the species establishes itself. It is closely related to the fascinating *E. horrida* Boiss. [colour p. 105] which forms cactus-like clumps at its type locality in the Wittepoort Mountains in the Willowmore district. Both species are characterised by the presence of up to 5 fertile and sterile peduncles springing from the same flowering eye, the main spine always developing from the sterile peduncle. Both are host plants to the parasite, *Viscum minimum*, which feeds on the tissue of the stem and in its fruiting stage produces bright orange ornamental berries. *E. horrida* can be distinguished from *E. polygona* by its much deeper angles and fiercer spines which are nearly 40 mm long, compared to just over 10 mm in *E. polygona*. The involucre glands of *E. horrida* are green, while those of *E. polygona* are dark purple. Three varieties of *E. horrida* have been described: var. *striata* occurs 24 km north of Steytlerville. This is a very handsome grey plant with wavy, conspicuously striped angles, the spines regular and fairly short. Var. *noorsveldensis* is found 18 km north of Jansenville. Dr Dyer, who found this variety in 1929, suggested that since it possesses purple glands it may be a link between *E. horrida* and *E. polygona*. Some 30 km north of Willowmore, huge plants with very long spines (also with dark purple involucre glands) occur which are known as var. *major*.

E. pillansii N.E.Br.: Western Cape: Montagu to Laingsburg and Ceres Karoo. A spiny dwarf species branching from the base and above. Both this species and *E. stellispina* have stellate spines, but *E. pillansii* is distinguished by its smaller size (up to 300 mm) and its fewer angles (7-9 compared to 10-16 in *E. stellispina*) and the spines appear to be of different origin. The spines are modified short shoots, some of which are fertile peduncles which are simple or branched at the apex. The stems have horizontal bands of dark and light green. Cyathia are borne at the apex of the branch stems, the peduncles up to 12 mm long, either ending with one cyathium or branching to form a cluster of flowers, the rays about 5 mm long. The involucre glands are dark green.



Euphorbia polygona and *Aloe ferox* on Trapalanda farm, Eastern Cape

E. stellispina Haw. [colour p. 105]: From Beaufort West to Williston in the Great Karoo, spreading westwards and northwards. It forms massive, impressive stands of thick 10- to 16-angled branches which reach a height of 500 mm (occasionally shoulder high). The cyathia are solitary at the stem apex, with short peduncles which develop a circle of sterile rays below the cyathium and these, according to the authors of *Succulent Euphorbieae* (1941), harden into the star-like spines so characteristic of the species.

2 Plants with paired spines of stipular or undefined origin, branches usually angled

It is pertinent to mention here that the presence and absence of spines and *their origin* is of taxonomic importance. Work on the tropical and subtropical species by Uhlarz in *Tropische und subtropische Pflanzenwelt* 9 (1974) indicates that, for example, the so-called 'stipular thorns' which had been interpreted as real stipules can be secondary out growths from the leaf base. He called them 'dorsal thorns'.

In the Tetracanthae both stipular and dorsal thorns are present, and well separated.

As far as this writer knows, research on the origin of spines in the many South African spiny Euphorbieae has not been carried out.

Dwarf species with paired spines

The first three species have spreading procumbent stems and all occur in the Eastern Cape

E. stellata Willd.: Port Elizabeth to King William's Town. The stem and root form one large tuberous underground body which produces prostrate radiating branches with 2 spine-bearing angles. The branches are green with a whitish feather-like lengthwise marking. The cymes usually bear 3 cyathia horizontally, the central male and deciduous, the laterals bisexual and maturing. **E. squarrosa** Haw.: Albany, Bathurst, Fort Beaufort and King William's Town districts. Very similar to *E. stellata* but more robust, the branches usually 3-angled

with a twist, without feather-like markings. Its name refers to the jagged outline of the branches made by the prominent tubercles which end in stout paired spines. It is impossible to give a length measurement for the aerial stems of this species and *E. stellata*. In exposed positions the stems are up to 100 mm, in dense thickets the stems can be up to a metre in length. *E. micracantha* Boiss. From Bathurst to Cradock districts. The third member of the small tuberous species which have procumbent branches is 4-angled with rather delicate diverging spines. However these characters are not constant and where it overlaps with *E. squarrosa* in Albany it is not easy to distinguish two species. There is a tendency here for the stems to adopt a suberect position.

E. schinzii Pax [colour p. 105]: From the Transvaal, its tropical forms extend into Botswana, northern Namibia and Zimbabwe. Root and stem have combined to form an underground body from which many rhizomes and prickly, aerial 4-angled branches are produced. It is usually wedged in firmly in rocky terrain on hills or granite koppies. Erect stems usually reach a height of 100-150 mm, about 10 mm thick, forming quite large clumps; the underground rhizomes set up new clumps separate from the parent. In late winter the bright yellow flowers appear and, with the first summer rains, the dull stems take on a fresh green appearance and the new soft red spines appear, later turning grey or brown. A solitary cyme of 3 cyathia develops at each flowering eye which is typical of the spine-paired euphorbias. The species is somewhat similar in habit to *E. knuthii* of Mozambique, but where the latter has pedicellate capsules and smooth seeds *E. schinzii* has sessile capsules and verrucose seeds.

E. aeruginosa Schweick.: On the northern slopes of the Soutpansberg in the Northern Province and throughout the length of the Limpopo valley; according to Steve Fourie the biggest specimens occur north of Punda Milia in Kruger National Park. This species is closely related to *E. schinzii*. It forms clusters of spiny branches to 150 mm in height (up to 400 mm recorded north of Punda Milia); its name, which means 'verdigris', refers to the coppery-green branches which have contrasting reddish-brown spines. The separate spine shields are up to 7 mm long, the paired spines up to 20 mm long, with a pair of short prickles above them. Another close ally of *E. schinzii* is the rare ***E. clivicola*** R.A.Dyer which is localised in the Potgietersrust

district of the Northern Province. Its underground body is about 150 mm long, the repeatedly-branching stem retractile in habit and mostly underground, with yellowish-green branches forming a low cushion 20-40 mm high above-ground. The stems narrow towards the apex, the tubercles are decussate and the small spines (up to 5 mm) are only present on the apical several tubercles. The cyathia are bright yellow and appear from June to August.

E. vandermerwei R.A.Dyer: Nelspruit in Mpumalanga. This dwarf species is distinguished from *E. schinzii* by a reduction in underground growth, both in rootstock and rhizomes, and the possession of a single bisexual cyathium in place of a cyme with several cyathia. In his series of articles on Transvaal euphorbias in *Euph. J.* (Strawberry Press) Fourie describes the chosen habitat of this species in crevices of the huge domes of granite in the Nelspruit area; the aerial twisted stems forming clumps up to 200 mm and bearing paired spines 10 mm long from prominent tubercles. The stems are 4- to 5-angled. Red bracts and pinkish involucre glands are a distinctive feature in this species.

E. enormis N.E.Br.: Pietersburg (Northern Province) and Lydenburg (Mpumalanga). In addition to meaning 'large', the latin word *enormis* also means 'of irregular shape', which latter description is applicable to this lowveld species. It is a spiny, dwarf species with sub-erect 4-angled branches up to 200 mm long (longer in shade), 20 mm thick, green with whitish feather-like markings. The branches are clavate or constricted into segments. As in the related *E. tortirama* and *E. clavigera*, the cyme which is solitary from each flowering eye bears 3 cyathia, the 2 laterals being bisexual, the glands yellowish-green.

E. tortirama R.A.Dyer: Mainly on the plains in the Waterberg and Potgietersrust districts in the Northern Province. The compacted underground stem and long root may lodge at depths of up to 600 mm in the soil. This species and its relative, ***E. groenewaldii*** R.A.Dyer (Pietersburg district) are the two most interesting members of this group. Both have aerial branches which twist, but only in *E. tortirama* do the older branches constrict into segments and the spine shields form a continuous horny margin. It also has a larger, more congested appearance with 20-50 branches which are 60-300 mm long (3-7 branches in *E. groenewaldii*). Where the two species meet, however, these vegetative differences



Euphorbia tortirama with details of cyathia
(from the drawing by Cythna Letty)

become less constant; both species have been heavily collected and their habitat drastically reduced by housing and agriculture. The tuberous body of these plants often takes on a divided, twisted appearance much admired by some collectors which unfortunately encourages the active export of the older plants.

E. restricta R.A.Dyer: Present in sourveld on several mountain tops of the Drakensberg in Letaba district of the eastern Northern Province. Two or more basal stems produce tufts of 4- to 6-angled flowering branches (about 160 mm long) which are constricted into deeply winged spiny segments with a continuous horny margin. The species is similar to some forms of *E. enornis* but is distinguished by its yellowish-green, unmarked branches with continuous horny margin.

E. clavigera N.E.Br.: The distribution of this species has been reviewed by Fourie (*Euph. J.* 5, 1988) and is extended from Swaziland to the lowveld in

the Northern Province and Mpumalanga from the Limpopo in the north to the Komati River in the south. The large cone-shaped tuberous body produces thickened underground branches which in turn develop clavate, 3-angled, aerial branches which have small separate spine shields on the wing-like angles. The aerial branches are 70-150 mm long and sub-erect, glaucous-green to fresh-green with paler 'zebra-markings'. The spines are prominent, up to 15 mm, grey, without supplementary prickles. Yellow cyathia appear in summer, on solitary cymes on which three cyathia are vertically disposed. This species is very close to *E. tortirama*, and *E. groenewaldii*; it is probable that *E. persistens* of Mozambique is conspecific with it.

Shrub-like species with paired spines

E. lydenburgensis Schweick.: Lydenburg district in the Northern Province. A shrub from 600 mm to 1.5 m in height in which the reduced main stem produces many greenish-yellow, slender, 4-angled erect branches, 10-15 mm thick. In September brilliant yellow flowers extend from the apex well down the branch in a striking manner. The spine shields present an almost continuous horny margin and this feature distinguishes it from its vigorous near relative, ***E. complexa*** R.A.Dyer of Barberton, Transvaal, in which the spine shields are separate. It branches from the base, forming clumps about half a metre in diameter. *E. complexa* flowers profusely on the young secondary branches from April to June. Both species have sessile ovaries.

E. louwii Leach: North of the Waterberg Mountains in the Northern Province (Transvaal). A spiny succulent species up to 500 mm (taller in the shade) which, like others in this group, belongs to the *Tetracanthae* and is probably closest to *E. complexa* which is a similar, shrubby, many-stemmed and rhizomatous species of the lowveld in eastern Mpumalanga. *E. louwii* branches mainly from the base, the stems 5-7 angled (*E. complexa* is usually 4-angled) becoming deeply ribbed vertically in the dry season, with a bluish colour and a pale undulating stripe between the angles. The spine shields are separate and possess an unusual 5 spines: a pair of prickles above, a pair of slender reddish, needle-like spines about 5 mm long and, at the bottom of the spine shield, a spinule 1 mm long. The fifth spine appears often in *E. aeruginosa* which belongs

in the same section. A horizontal cyme of 3 cyathia develops, and extra bisexual cyathia may develop in the axils of the bracts of the peduncle. The glands are yellow, the ripe capsules dark purple.

E. waterbergensis R.A.Dyer [colour p. 105]: Present on the north-western side of the Waterberg Mountains in the Northern Province. The plant branches from the base to 1.5 m or more in height; the 4- to 6-angled stems segmenting at intervals from 20 to 200 mm. The paired spines occur on a continuous horny margin. This species is allied to *E. lydenburgensis* but differs in the darker green colour of its slender branches; the more pronounced horny margin on the angles; the frequent occurrence of 4 cyathia in place of 3, and the shortly stalked ovary which, however, does not exert from the involucre. At first the species was thought to be rare in location but it was later found to be well established in its area.

E. griseola Pax: Transvaal, Botswana, Zimbabwe, Zambia. Another species with slender bushy habit is *E. griseola* which was found by Marloth in 1900 on the north slopes of hills near Lobatsi in Botswana. The *griseola*-complex was sorted out by Leach: subsp. *griseola* is a branching shrub usually less than 1 m in height, shallow-rooted, with 4- to 6-angled (usually 5-angled) branch stems which are never markedly segmented. It is linked to *E. heterochroma* (East Africa) but the stems of the latter are segmented at intervals. The stems of *E. griseola* are green with lighter markings between the angles which are sinuate-tubercled. Spines are paired, slender, 5-7 mm long, with minute prickles at the base which later disappear; the name 'griseola' means grey and refers to the spines. The inflorescence is a solitary cyme with usually 3 horizontal cyathia, glands yellow. The capsule is long-pedicelled, exerted, but straightens just before it explodes. The typical subsp. is well distributed in Botswana, Transvaal and Zimbabwe. In the Transvaal, the plants have a spreading habit, the older branches becoming prostrate and rooting themselves. Plants at high altitude in the Soutpansberg may be less than 600 mm in height, while those along the Limpopo River are up to 1.5 m tall (Fourie 1987). Subsp. *mashonica*: shrubs with a tree-like habit, often attaining a height of 3.5 m; easily distinguished by the many angled main stem. These occur chiefly in the north of Zimbabwe. Subsp. *zambiensis*: a shrub up to 2 m in height, with well-defined stem segments and confined to

Zambia. The fruits of *E. griseola* are exerted out of the involucre on long recurved pedicels, thereby distinguishing the species from *E. lydenburgensis* and *E. complexa*.

E. rowlandii R.A.Dyer: On sandstone ridges north-west of Punda Maria in the Kruger National Park in the Northern Province and in southern Zimbabwe. Shrubby plants, about 1-2 m tall, and about the same in width, with the main trunk very reduced, producing many 5- to 7-angled branches constricted into segments 70-150 mm long which are 30-50 mm broad at the base and narrowing upwards; angles acute with a continuous horny margin. The plant is well-armed with upwardly divergent paired spines. This is an attractive species with its many stems which can look like narrow columns of inverted cones. Flowers yellow and capsules purple. *E. confinalis* is a near neighbour and also a fairly near relative.

E. kaokoensis (W.D. & S.) Leach: Namibia: Northern Kaokoveld. At first tentatively designated as a variety of the Angolan species *E. subsalsa* in 1941, this taxon was elevated to specific level by Leach in 1976. It is a low-growing shrub branching from the base, its thorny erect branches about 20 mm thick, with 5-7 angles, the spine pairs set close together, and a third shorter pair sometimes develops. It is a very attractive plant with spines russet when young, turning grey later. It is distinct from the nearby *E. subsalsa* which has 4-angled branches and horizontally-placed cyathia both of which characters are typical of the Section *Tetracanthae*. (See note on this section under *Euphorbias* of Angola.)

E. otjipembana Leach: Namibia: occurs on the slopes of the Baynes Mountains in the Kaokoveld. A spiny shrublet of the *Tetracanthae* group with branches 150-200 mm long, 4- to 6-angled and 20-30 mm thick. The lower pair of spines is divergent, up to 9 mm long, the upper pair is barely 1 mm long. It is apparently related to *E. subsalsa* subsp. *fluvialis* but is distinguished by its green colour, its segmented branches and smaller size.

E. virosa Willd. [colour p. 105]: The typical subspecies is a vigorous shrub up to 3 m high distributed from south of Vioolsdrift on the Orange River to Prieska and northwards along the Fish River to the Kaokoveld and southern Angola. The short, often twisted main stem gives rise to a large number of branches 50-60 mm thick, constricted regu-



Euphorbia virosa in Kaokoveld

larly into segments 50-80 mm long. The spine pairs are dark red and shiny when young, becoming grey. Subsp. *arenicola* is found on the coastal belt south of Moçâmedes in Angola. It is a much smaller, spreading plant with an average height of 0.5 m. It flowers generously in late winter, whereas subsp. *virosa* flowers sparingly in the summer. Unlike the following three species in which 3 cymes develop from a flowering eye, in *E. virosa* a solitary cyme develops.

E. venenata Marloth [colour p. 105]: A second large shrubby euphorbia which was first recorded by Marloth from the Tsarris Mountains in Namibia. It also occurs in the Tsumeb region, where it grows on the banks of Lake Otjikoto. The branches (up to 2 m high) resemble *E. virosa* in general habit, but the stem segments are wider at the lower end, as in *E. cooperi*. Its inflorescence is also similar to that of *E. cooperi*, as it has 3 cymes consisting of 3 vertically disposed cyathia arising from each flowering eye on the apical segment of the branches. The capsule is sessile or nearly so. In general habit it is

quite different from *E. cooperi* because its main stem is reduced and below ground, whereas *E. cooperi* is a stemmed tree, although young plants appear to be shrubby.

E. avasmontana Dinter [colour p. 106]: The third in this group of large plants has its type locality in the Auas Mountains and northwards in Namibia where one plant may produce up to 50 sturdy 5-angled branches to a height of 2 m. The branches are slightly constricted into segments; the spine shields form a continuous margin along the angles; the spine pairs are 10 mm apart and fiercely rigid. There are 2-3 cymes from each flowering eye, the 3 cyathia vertically placed, the capsule is exserted from the involucre on a slender pedicel. *E. volkmanniae* Dinter was briefly described (and not validly published) from a 5-angled plant collected in the Tsumeb region of Namibia and is probably a form of *E. avasmontana*.

E. hottentota Marloth: Richtersveld, Botswana, southern Namibia. Although this species reaches the same height as the last several species, it is easily distinguished by its narrow (up to 40 mm thick) 5- to 6-angled branches, which are only slightly constricted at intervals or not at all. As in *E. avasmontana*, the capsule is exserted from the involucre.

E. barnardii W.D. & S.: Lydenburg district, very localised in Sekukuniland where it was found and north on the Strydpoort Mountains in the eastern Transvaal. A small spiny shrub up to 600 mm in height, with light-green 5- to 6-angled branches segmented after the fashion of *E. cooperi*. Unlike the latter, the main stem does not elongate into a tree. Spine shields unite to form a continuous grey margin. As in *E. virosa*, this species has a solitary cyme at each flowering eye with 3 cyathia placed vertically. Due to the destruction of its habitat this small species is endangered.

E. perangusta R.A.Dyer: North of Zeerust in the Marico district in the North West Province. A vigorous spiny shrub up to 1 m in height; main stem reduced producing a thicket of deeply-winged 5- to 7-angled branches which are green with light-green radiating bands. The capsule is exserted on a slender pedicel. Like the last species, this plant is rare and endangered. Traces of uprooted and eaten plants have been attributed to porcupines, which forage on these plants in times of drought. ***E. kno-***

belii Letty which also occurs in the Marico district is similar in size, habit and inflorescence, but the branches which are also marked in yellow and green lack the thin wing-like angles typical of *E. perangusta*. Both overgrazing and density of population in the area have caused a decline in the numbers of *E. knobellii* which is now a vulnerable species. (Fourie in *Euph. J.* 4, 1987).

E. pseudocactus Berger: KwaZulu-Natal: in the Muden valley where the species forms dense colonies. As in the last two species the reduced main stem is buried and produces spreading-ascending 4- to 5-angled branches up to 1 m in height; the green stems have decorative V-shaped yellow markings or no markings at all. It differs from the last two species in having a larger capsule which is subsessile; the deeply 3-angled shiny capsules are red and make a fine show when ripening.

E. grandicornis Goeb.: A distinctive shrubby species of the lowveld in northern KwaZulu-Natal, Swaziland and Mozambique from the Limpopo to the Tugela rivers, and in a few isolated patches in the south-eastern Transvaal and Kruger National Park. Formidable, superbly armed and fascinating, this plant reaches a height of about 2 m. The main stem is again below ground, giving rise to many aerial stems which have 3 flattened wing-like wavy angles, from which fierce spines up to 70 mm project. In season, it produces attractive yellow flowers followed by 3-angled red fruits. Subsp. *grandicornis* occurs in the areas mentioned, and subsp. *sejuncta* is restricted to the granite hills of Nampula in northern Mozambique. It is an isolated population of plants much smaller than the typical subspecies, being only about 0.5 m in height, and having 2- to 3-angled branches.

E. grandialata R.A.Dyer [colour p. 106]: Olifants and Steelpoort river valleys (Eastern Transvaal). This beautiful shrub is very similar to *E. grandicornis* in general habit, but it is usually 4-angled and has much shorter spines; the deeply constricted pyramidal branch segments are conspicuously marked with pale yellowish-green on darker green. It is a large shrub, up to 2 m tall, with no main trunk visible. It is interesting to consider the tendency of some of the leafless euphorbias to evolve towards deep, narrow stem angles, which are almost foliaceous in design and certainly in function, giving the plant a much larger surface area for light and gaseous exchange, both vital for food-making.

It is also interesting to note that this modification is best developed in those species which tolerate a higher rainfall.

E. coerulescens Haw [colour p. 106]: In the eastern Karoo in the Jansenville and Somerset East districts large areas are covered by the 'blue euphorbia', a shrubby plant which readily spreads by means of rhizomes. It also occurs in the Little Karoo - large tracts of it are present north of Calitzdorp. Known as the 'soet noors', this plant is cut up and fed to stock in time of drought. In the typical plant the spiny branches which are 30-50 mm thick and up to 1.5 m high are constricted into rounded segments. Easily confused with this species is *E. ledienii* Berger which has a more southerly distribution in the Uitenhage and Port Elizabeth areas; it is less prominently constricted into segments and does not develop rhizomes. It is usually taller than *E. coerulescens* and, being poisonous, is not used as a fodder plant. **E. bothae** Lott & Godd. is a composite species which was published with an inconclusive description in 1928; it refers to the variable, possibly hybrid forms of related shrubby euphorbias which have colonised parts of the Fish River catchment area.

Tree species with paired spines

E. cooperi N.E.Br. [colour p. 106]: A widespread tropical species which is generally from 3 to 5 m in height. The juvenile form consists of a cluster of branches at ground level, which tend to hide the main stem, the latter only becoming obvious when the lower branches wither and fall off. The branches are 5- to 6-angled, deeply constricted into segments which are wider at the lower end. The stem angles are deeply winged, with grey spine shields continuous along their margin. The latex of this plant is extremely poisonous. Up to 3 sessile cymes develop from each flowering eye and each produces 3 cyathia which are arranged vertically; the fruits are deeply angled. *E. cooperi* is a variable species: var. *cooperi* has the widest known distribution and occurs at altitudes from 300 to 1350 m in KwaZulu-Natal, Swaziland, Transvaal, SW Mozambique and Zimbabwe. It is recorded in Zimbabwe from Mtoko, Matopos, Chipinga, Umtali, Devuli River, Lundi River and Nuanetsi. Var. *us-sanguensis* is the more easily distinguishable one of the three, having very regular, circular branch segments, and the fruit has a shorter pedicel than in the



Euphorbia cooperi var. *cooperi* in Northern Province



Euphorbia cooperi var. *calidicola*

other varieties. It occurs at altitudes of 1200 to 1800 m in Tanzania, Zambia and Malawi. The type locality of var. *calidicola* is the Wankie district of Zimbabwe. It also occurs north of Kariba in Zambia, at Monkey Bay on Lake Malawi and in the Tete district of Mozambique. According to Leach var. *calidicola* is a riverine plant of the Zambezi areas, and is difficult to distinguish from the typical variety. The branches have segments which vary in shape and size, and the spinescence is variable from strong to weak.

E. angularis Klotzsch: Is closely related to *E. cooperi* and only occurs on Goa Island, off the northern Mozambique coast, where it forms the dominant vegetation. It is a densely-branching, spreading shrub with a reduced, gnarled main stem. The segmented 3-angled branches are strongly winged. Although it is somewhat similar in habit to *E. grandicornis* subsp. *sejuncta* present on the adjacent mainland, the branches do not have the armour of *E. grandicornis*, nor do the stem margins undulate as in the latter species.

E. zoutpansbergensis R.A.Dyer: A small tree euphorbia which occurs on the southern cliffside at Wylliespoort and along the western Soutpansberg in the Northern Province. It is much more graceful than *E. cooperi*, its segmented, 6-angled branches being only 20-35 mm thick. The tree reaches a height of up to 5 m, with the old branches falling away and leaving a fairly substantial exposed trunk. Another krantz-clinging small tree of similar habit is *E. keithii* R.A.Dyer which occurs near Stegi in Swaziland. Its dark green branches are usually 5-angled and, as in *E. zoutpansbergensis*, 3 cymes develop from each flowering eye, each cyme having 3 vertically placed cyathia.

E. sekukuniensis R.A.Dyer: Occurs north of Roos Senekal and in the Steelpoort River valley in Mpumalanga. A spiny tree from 2-7 m tall; the trunk simple or rarely dividing; the crown of obtusely 4- or 5-angled branches having a diameter of about 2 m. It appears to be allied to *E. evansii*, *E. tetragona* and *E. grandidens* because of its solitary cymes which consist of 3 horizontal cyathia, but differs from these in having its spine shields form a continuous margin.

E. excelsa W.D. & S: Sekukuniland and Olifants River hills (Transvaal). The name 'excelsa', which means high, is well applied to this stately tree euphorbia which is 7-10 m tall at maturity. It has a single erect stem and a great crown of curving, semi-erect, 4-angled branches which give it a 'feather-duster' appearance. *E. excelsa* is unique among the South African tree euphorbias in that it has 4 peduncular bracts instead of the usual 2, and each cyme possesses 5 or more cyathia in place of 3 in other species.

E. confinalis R.A.Dyer: Transvaal, Zimbabwe and Mozambique. Another candelabriform species which is up to 10 m tall, with a crown of curving erect, 3- to 4-angled branches which on falling leave the trunk bare. There are 1-3 cymes at the flowering eye,

each consisting of 3 vertically placed cyathia; the capsule is exerted from the involucre. The typical subspecies extends along the Lebombo range in South Africa and Mozambique, being plentiful at Komatipoort and south of the Inkomati River. Small colonies occur in the Chipinga district and near Mount Selinda in Zimbabwe, and along the Buzi River in Mozambique. Subsp. *rhodesiaca* has a stouter appearance and occurs in the Melssetter, Buhera and Chibi districts, as well as south-west of the Matopos.

E. evansii Pax [colour p. 106]: Barberton and Belfast districts in Mpumalanga and in the Muden valley in KwaZulu-Natal. A spiny tree up to 10 m high, its main stem cylindric or obscurely angled, with several stem-like branches, each producing secondary branches and branchlets in whorls, these being slender, unsegmented, acutely 3- or 4-angled, with separate spine shields, the paired spines without prickles at the base. The cymes are solitary with 3 horizontally placed cyathia; the ovary and capsule exerted. The species is nearest related to *E. grandidens* of the coastal regions in the Eastern Cape.

E. grandidens Haw.: Eastern Cape coastal region from Humansdorp to East London and the Trans-



Euphorbia grandidens near the coast at Port Alfred

kei. A graceful spiny tree from 10-16 m high, with cylindric main stem and several erect stem-like branches which have numerous secondary branches and branchlets in whorls. The branches are not segmented, usually 3-angled with the angles sinuate-tubercled; the short paired spines often have an accompanying pair of prickles. Its inflorescence is similar to that of its nearest ally, *E. evansii*, which extends from the Muden valley in Natal to south-eastern Mpumalanga.

E. triangularis Desf. [colour p. 106]: Eastern Cape, Transkei, KwaZulu-Natal. It is the commonest tree euphorbia in the Eastern Cape, often in dense groups from 9-18 m tall along the river banks and hills. The cylindric trunk may have several stem-like branches, each of these producing whorls of branches which are constricted into segments and 3- to 5-angled, the angles wing-like, up to 45 mm at their broadest, green, the central core about 20 mm thick; 2-3 peduncled cymes develop from

each flowering eye, each consisting of 3 vertically placed cyathia. The 3-angled form occurs in the Eastern Cape and it must have been these plants which prompted the name of the species. ***E. curvira*** R.A.Dyer: Eastern Cape: Albany, Peddie and Fort Beaufort districts. A small tree usually under 5 m tall with a cylindric trunk which is simple or with 3-5 stem-like branches. Secondary branches are usually 4-angled and deeply constricted into segments. Its inflorescence is similar to that of the closely allied *E. triangularis*, with the exception that the capsule is not exserted while that of *E. triangularis* is; in general appearance *E. curvira* is a much shorter tree.

E. tetragona Haw. [colour p. 106]: Eastern Cape from Uitenhage to the Transkei. This species often forms dense stands of trees usually not more than 9 m tall. The main trunk, obscurely 6- to 8-angled and about 150 mm thick, produces up to 5 or more stem-like branches. The secondary branches and branchlets are whorled and 4- to 6-angled, mostly with a quadrangular appearance. It is these secondary 'square' stems from 15-20 mm thick which make recognition of this species so easy. Spines without additional prickles are present on the young branches, becoming obsolete with age. The cymes are solitary at each eye as in *E. grandidens*, *E. evansii*, *E. excelsa* and *E. sekukuniensis*.

E. ingens E.Mey. [colour p. 106]: Widespread in KwaZulu-Natal, Swaziland, Transvaal, Zimbabwe, Mozambique, Zambia and further north. The use of the name *E. candelabrum* for this species is incorrect, as this name was applied by Welwitsch to an Angolan tree species and was validly published in 1856 (*Annaes do Conselho Ultramarino, Parte nao Oficial*, ser 1 [caderno 36, 1856]). Although not the tallest of the tree euphorbias in South Africa, *E. ingens* is the most massive. It is readily distinguished from the others by its habit of not shedding its branches, but continues rebranching each year forming a densely packed, dark green crown. It is surprising that sufficient light for the plant's needs can enter this dense ramification. The common name for tree euphorbias in South Africa is 'na-boom', which refers to *E. ingens* as well as *E. grandidens*, *E. cooperi* and others. The name is derived from the Afrikaans 'boom' meaning tree, and 'na' (from the Hottentot language) meaning strong. At Naboomspruit in the Northern Province the name refers only to *E. ingens* which is very prevalent in the surrounding veld.



Euphorbia triangularis with deeply constricted segments

ANGOLA

A second group of tree euphorbias exists in Angola. The likeness in habit between eastern and western complexes suggests a possible affinity which has become more likely since the location of *E. confinalis* subsp. *rhodesiaca* in south-west Zimbabwe. Just as the grouping and description of the South African succulent Euphorbiaceae are almost completely due to the untiring efforts of Dr R. Allen Dyer, so is present knowledge of the Angolan euphorbias attributable to the work of Mr L.C. Leach formerly of Salisbury, Zimbabwe, following his expeditions to that country in the company of Mr I.C. Cannell in 1967 and 1970.

Trees with paired spines

E. candelabrum Welw.: Occurs along the coastal belt from north of Luanda to just south of Benguela. A tree of up to 15 m in height, it produces several grey stem-like branches which are topped with a number of upward-curving, winged flowering branches which are constricted into segments of varying lengths, usually 3-angled, weakly spinescent with separate spine shields. The pedunculate inflorescence is reddish-purple and the deeply-lobed capsule is well exserted from the involucre. (see reference to this species under *E. ingens*.)

E. teixeirae Leach [colour p. 107]: Malanje and Cuanza-Sul districts. The species is generally found at the bottom of steep, wooded hills, where the trees reach a height of about 10 m, the stout trunk usually branching near the base into a large number of trunk-like branches each with its head of flowering branches which have 3-5 angles with slightly sinuate-dentate margins. It is easily distinguished from *E. candelabrum* by its greenish, subsessile inflorescence and the obtusely 3-lobed capsule.

E. vallis Leach: A limited distribution in the Huila district. Up to 12 m in height, with a cylindrical trunk branching at the base and more freely above. It is distinguished from the related *E. teixeirae* by its deeply-winged, 3-angled branches which have deeply tuberculate, toothed margins. The inflorescence is subsessile and the capsule subacutely 3-lobed.

E. eduardoi Leach: Coastal distribution north and south of Moçâmedes, occurring in the Kaokoveld

in Namibia and overlapping *E. candelabrum* in its northern limits. It has a candelabriform habit with a simple trunk, reaching a height of about 10 m. The branches are stout and obscurely segmented, with more than 3 angles, stout spines and a continuous horny margin. The pedunculate inflorescence is yellow and the capsule is only shortly exserted. Its nearest relative is probably *E. fortissima* of Zimbabwe.

E. parviceps Leach: Occurs in the region of sulphur pans 25 km south-west of Gabela, on rocky outcrops with *Aloe zebrina* and *A. littoralis*, and in the Benguela district on the escarpment east of Lobito. The trees near Gabela are dwarfed to 3 m and less, but elsewhere their height is up to 15 m. An unattractive species which has small heads of weak branches set on tall lichen-covered trunks.

E. viduiflora Leach: This species grows in the area around Catete where it is used as a boundary marker in the cotton fields. Quite different from the other Angolan tree euphorbias, it resembles a small *E. ingens* and does not lose its older branches. It develops into a small tree 2-3 m high and the same in the upper diameter, with a densely branched head of angular, spiny, erect branches with wing-like angles. The plants have not been known to flower and may have all originated from the same sterile clone. As early travellers in this region have not mentioned it, it is probably a recent introduction.

Shrubs with paired spines

E. ingenticapsa Leach: Benguela district. A robust, erect shrub about 2 m tall, branched from the base and strongly spined. Its general habit is very similar to that of *E. virosa* subsp. *virosa*, which is common in Angola south of Moçâmedes. However, it is apparently more closely aligned with *E. venenata* of Namibia. The cymes have 3 vertically placed cyathia and the triangular capsule is remarkable for its size, being 26-28 mm across the angles.

E. virosa Willd. [colour p. 105]: Subsp. *virosa* occurs on the coastal plain south of Moçâmedes. It is a tall vigorous shrub up to 3 m high, with thick erect branches constricted into segments 50-80 mm long. (See earlier entry under Namibian species.) Subsp. *arenicola* which occurs in the same area is a smaller, spreading plant less than 1 m in height.

E. faucicola Leach: Found on the cliffsides of the Cuchi River in the Bie-Cuando-Cubango district. It appears to be closely related to *E. seretii* of the Congo. *E. faucicola* ('gorge dweller') is a candelabriform shrub, usually 1-1.5 m tall, branching from the base, the branches 3-4 winged, constricted into segments which are mostly suborbicular. The single pedunculate cyme has 3 vertical cyathia.

E. gracilicaulis Leach: Occurs with baobab trees in the Benguela district 18 km west of Caimbambo. A spiny shrub or small tree up to 3.5 m with a central stem bearing slender 5- to 6-angled branches with grey spine pairs. The older branches dip towards the ground.

E. atrocarnesina Leach: Cuanza Sul: Gabela. A spiny shrub with handsome blackish-crimson inflorescences on short peduncles, each of which bears a solitary bisexual cyathium, which is unusual among the spine-paired euphorbias. Leach records that the plant has great regenerative power, producing new branches from the remains of plants which have died back. The branches of the mature plant have 4-6 broadly-winged angles, deeply constricted into rounded sections. The typical plants are rather small, up to 1.5 m with a short trunk. At higher levels in the nearby hills, taller plants occur which have been separated as subsp. *arborea*.

E. dispersa Leach: On bare granite hills west of Mariano Machado. The species is apparently closely related to *E. seretii* subsp. *variantissima* from the Kabompo Gorge in Zambia, and *E. faucicola*. *E. dispersa* is a candelabriform shrub or small tree up to 2.2 m tall, with simple branches constricted into segments with 4-5 angles armed with stout spines.

E. strangulata N.E.Br.: Malanje district. A low, spiny shrub up to 600 mm high with a short main stem and spreading segmented branches. In the arrangement of its yellow inflorescence and in habit it has affinity with *E. barnardii* of the eastern Transvaal.

E. semperflorens Leach: South-western Angola. In general habit, this spiny, 1 m tall euphorbia resembles *E. grandicornis* because of the undulating wings on its stems and prominent spines. It is a long-flowering species, showing successive development of cyathia.

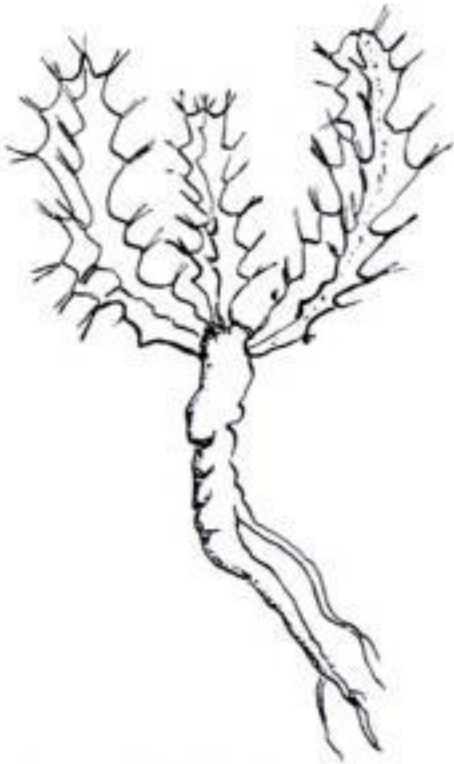
E. cannellii Leach: Benguela district: 17 km west of Cantengue. A spreading, straggling shrub up to 700 mm high and 3 m in diameter, the branches sometimes rooting when in contact with the ground; variably constricted into segments which are 4-winged. It is nearest related to *E. atrocarnesina*, *E. dekindtii* and *E. semperflorens*. All of these are



Euphorbia gracilicaulis – shrub or tree up to 3.5 m



Euphorbia atrocarnesina – shrub under 1 m



Euphorbia dekindtii – dwarf up to 200 mm

fairly small, stemless shrubs which have paired spines longest at the widest portion of the stem segment, a sessile inflorescence with a single bisexual cyathium, and most have a long flowering season. Leach named his new species after I.C. Cannell, his companion in his Angolan travels.

E. dekindtii Pax emend. Leach & Cannell: Huila district. A dwarf species which has segmented, winged branches up to 200 mm long. It has an underground caudex which sometimes forms a gnarled body above the ground.

E. opuntioides N.E.Br. [colour p. 107]: First collected by Welwitsch in 1857, and again by Leach and Cannell in 1967 from a position overlooking the Caunza River in the Malanje district. It is a dwarf plant which looks like a miniature prickly-pear. It is less than 200 mm high and has very attractive deep crimson flowers.

The Section Tetracanthae Pax is a natural group of euphorbias. It is almost entirely tropical and in Africa it is divided into two parts: the far greater distribution is eastern, from the horn of Africa to about 27°30'S (with Swaziland and northern Free State at its southern limits); the small western dis-

tribution extends from south-western Angola to northern Kaokoland in Namibia. The species in this group are shrubby, dwarf to medium (seldom over 1 m tall), usually 4-angled, with 2 pairs of spines on a cuneate (wedge-shaped) shield which runs along the angle but is seldom continuous. The inflorescence consists of a cyme of 3 horizontally placed cyathia, the ovary included and later the capsule hardly exerted (Leach in *Dinteria* 12, 1976). Both *E. otjipembana* and *E. kaokoensis* belong to this western alliance and are described under the Namibian shrubby species with paired spines. (See note on the origin of spines under 2: Plants with paired spines, page 130.)

E. subsalsa Hiern: A desert species which occurs from Benguela southwards to Moçâmedes. The name, which means 'somewhat salty', refers to Salt Rock in southern Angola where the plant was discovered by Welwitsch. The typical plants are widespread; sparingly branched from the base to a height of 600 mm, the 4-angled stems are about 10 mm thick, fiercely spined and marked with a pale



Euphorbia subsalsa subsp. *fluvialis* in Kaokoveld

stripe. The major pair of spines are up to 12 mm long, the lesser ones above them are 1-4 mm, the spine shields are long but not continuous. The inflorescence is typical of the tetracanthous group. Subsp. *fluvialis* occurs on both sides of the Cunene River at the Ruacana Falls in the Huila district. The plants which just enter Namibia are in the northern Kaokoveld and have a bushy, more robust habit and the branches are unmarked. Differences which must be independent of soil and climatic conditions concern the involucre: the concave glands are reddish, the male flowers separated into distinct bundles. In *Succ. Euphorbieae* 2 (1941) a group of 5- to 6-angled plants were mentioned under *E. subsalsa* and the name var. *kaokoensis* proposed. Leach later elevated this taxon to species level (see *E. kaokoensis* under Namibian species). They should not be confused with *E. subsalsa* subsp. *fluvialis* which is also Namibian and 4-angled.

E. coerulans Pax [colour p. 107]: Huila district: Humpata. An uncommon insignificant dwarf species with a large tuberous root and many short branches (60-70 mm long) with prominently humped tubercles. The stems are 4-angled and prominently crenate on the angles, the 'humps' about 5 mm high, each spine shield carrying 2 pairs of spines. The single pedunculate cyme bears 3 horizontal cyathia.

E. demissa Leach: Benguela district. A dwarf species discovered by Leach and Cannell on granite ridges about 14 km east of Sousa Lara, in association with *Aloe andongensis* and *Huernia volkartii*. Its name refers to its lowly habit of short, crowded branches which develop from the compacted stem area at the top of the woody taproot. The branch stems are 4-angled, deeply concave between angles; the 4 spines are short, and the pairs much the same in length, the spine 'sets' so close together they look like spiders crawling up the stem. The inflorescence is yellow, the cymes solitary with 3 horizontal cyathia.

E. nubigena Leach: Common on the granite hills in the Cuanza Sul district. It is a basally branching plant with weak, slender branches 200 to 400 mm tall and spreads by means of rhizomes. Among the western *Tetracanthae* this species may be closest to *E. coerulans* but is taller, more slender, rhizomatous, and has weaker spines. The name 'nubigena' which means 'born of a cloud' was chosen by

Leach because his camp site at the type locality (1300 m altitude) was covered by cloud. In the typical variety, the flowers are yellow; var. *rutilans* which occurs just west of Quibala is distinguished by its bright red cyathia and fruits.

E. scitula Leach: Occurs in the coastal region near Lobito. In the 'elegant euphorbia' the main stem and root form a compact storage body, which at ground level produces several serpent-like, bright green branches up to 500 mm long, marked with conspicuous longitudinal whitish stripes. The 4-angled stems are more or less flat between the angles, the spine pairs (as in *E. demissa*) nearly the same in length and spidery. In most respects the inflorescence is typical; the capsule remains green until ready to dehisce, and the seeds are cream-coloured.

E. cuneneana Leach: Huila district: on gravel slopes near Naulila. The typical subsp. has a large underground storage organ which gives rise to straggling branches up to 900 mm long with a pale winding stripe between angles (in young growth). One specimen is recorded as having an underground body with a mass of 22 kg! Again, weak spinescence is encountered, this time the spine 'sets' are wide apart, up to 22 mm distant. Subsp. *rhizomatosa* is plentiful near Roçadas where it spreads by means of rhizomes, and is further distinguished by the red colour of the young cyathia, those of the typical subsp. being yellowish throughout development. The inflorescence of *E. cuneneana* distinguishes itself from its allies by the presence of the two widely spread lateral pedunculate cyathia, the central male cyathium dropping away or developing from a bracteate base.

Shrubs with rod-like branches, without paired spines, but sometimes with stem tips hardened to form spiny points

E. berotica N.E.Br.: Moçâmedes district. A glabrous shrub with slender, terete branches at first succulent, later woody, about 750 mm high with a thick horizontal rhizome giving rise to daughter plants. The species is closely related to *E. mauritanica*, but can be distinguished by its smaller size, eventual woodiness of the branches, the presence of rhizomes and narrower leaves. It is also related to *E. gossypina* which occurs in Zimbabwe, Tanzania and Kenya.

E. negromontana N.E.Br.: Moçâmedes district. A unisexual, rod-like shrubby species which is apparently rare. It has an erect to sprawling habit, from 350-450 mm in height. Both *E. conformis* N.E.Br. and *E. fragiliramulosa* Leach are synonyms of this species.

E. carunculifera Leach: Large numbers of the bushy typical subspecies inhabit the coastal area between Moçâmedes and Lucira. Subsp. *subfastigiata* is a more erect shrub or tree and occurs about 200 km north of Lucira. **E. congestiflora** Leach of the Moçâmedes district is a related semi-succulent shrub up to 2 m tall with rather long whip-like branches. Also related to *E. carunculifera* are *E. gregaria*, *E. gummifera* and *E. damarana* in the south, and *E. tirucalli* which occurs around Luanda and further north. **E. tirucalli** enjoys a heavier rainfall and is distinguished from the other terete-stemmed species by having fine longitudinal striations on its branches. This plant has followed settlements made by man and has long been used as a hedge plant, fish poison, medicine and, unsuccessfully, for the production of rubber. It has a world-wide tropical and sub-tropical distribution and is most probably of East African origin.

E. curocana Leach: Moçâmedes district: in the vicinity of the Curoca River. A dwarf, densely-branched species about 300 mm tall with a tuberous root. The terete branches become woody, with the apex hardening into a spine. *E. curocana* is closely related to *E. lignosa* which occurs in southern Namibia.



Euphorbia carunculifera

E. indurescens Leach: Moçâmedes district: in arid areas mostly between the Giraul and Curoca rivers. A branching dwarf species usually less than 200 mm in height; closely related to *E. curocana* but more succulent; on becoming woody the branch apices do not form spines.

ZIMBABWE

The higher, cooler levels in Zimbabwe extend from the Umvukwe Range through Harare to the eastern Highlands on the border of Mozambique. From Marondera (Marandellas) the higher ground proceeds in a south-western direction to Bulawayo and the Matopos, dropping away on each side to the hot, dry lowveld in the south-east, and the equally hot, but wetter, Zambesi valley in the north. In spite of these variable conditions and a summer rainfall the *Euphorbia* genus is conservatively represented, there being present about 20 species of interest of which one quarter are endemic.

Tree species

E. confinalis R.A.Dyer: The main distribution of this large candelabriform tree euphorbia is along the Lebombo Range in South Africa and Mozambique, as well as on the coastal plain of Mozambique, with several small colonies in south-eastern Zimbabwe. The stout 3- to 4-angled juveniles of the subsp. *confinalis* are different from the tall, slender 5-to 6-angled, later-branching young plants of subsp. *rhodesiaca*. The Zimbabwe subspecies occurs in the Chibi and Bikita districts; their presence at the Matopos is regarded as a possible link between the tree euphorbias of the Transvaal and Eastern Cape and their counterparts in Angola. *E. confinalis* was figured on one of the postage stamps issued to commemorate the *Aloe 75 Congress* held in Salisbury.

E. ingens E.Mey. ex Boiss. [colour p. 106]: This large tree euphorbia is present in most areas of Zimbabwe although rare in the Zambesi area from the Victoria Falls to Lake Kariba. Although the massive *E. ingens* is hardly likely material for grazing, it has been reported that the rhinos in the Kafue National Park in Zambia feed on the young plants of this species. (See main entry under South African species.)

E. cooperi N.E.Br. ex Berger [colour p. 106]: It is

of general interest that Thomas Cooper, after whom the species was named, was the father-in-law of N.E. Brown. There was some confusion about the original material being *E. cooperi* or *E. ingens* but it is quite impossible to confuse these trees especially when growing together, *E. ingens* has a very dense crown and does not shed its branches. Var. *cooperi* is prevalent over at least two-thirds of Zimbabwe from west-central across to the eastern border. Var. *calidicola* occurs only in the dry hot river valleys of the Zambesi and its tributaries. Whereas the typical variety has 4- to 6-winged branch segments with the wings 5-6 mm thick, var. *calidicola* is 3- to 4-winged and the wings are only 3 mm thick. It is recorded from Mozambique, Zambia and Malawi.

E. fortissima Leach: Deka and Zambesi Rivers in the Wankie district. An unusual small candelabrum-like tree up to 5 m in height; it is related to *E. cooperi* but easily distinguished from it by its long peduncles and larger capsule exerted on a thick pedicel. The dark green branches have fewer angles (usually 3) but it is the persistence of the long curved segmented branches which is remarkable and quite different to *E. cooperi*, in which the old branches fall away, revealing the stem.

E. halipedicola Leach [colour p. 107]: A spiny shrub or small tree up to 5 m tall which has its main distribution along the low coastal plain (to which its specific name refers) in Mozambique from the Zambezi to the Save River. Its further distribution was established by Alan Percy Lancaster who found scattered colonies in the Sabi valley, Chipinga district. Notable are the wavy margins of the winged segments and the crowded nature of the flowering cymes. Lancaster noted that, at a distance, the species could be mistaken for *E. cooperi*.

E. lividiflora Leach: As in the case of the last species, *E. lividiflora* was at first thought to be confined to the swampy coastal region of Mozambique, only to be found later in a few scattered colonies in the Sabi valley in Zimbabwe. A succulent tree of about 4 m, the species is remarkable for its striking cyathia which have dark purple shining glands. There is a dramatic photograph of the cyathium in *Euph. J.* 3, 1985. The main branches are 5-angled, the secondary branches 4-angled, sinuate-tuberculate.

E. tirucalli L.: Widely distributed in Africa and be-



Euphorbia halipedicola showing undulation of stem angles



Inflorescences of *Euphorbia halipedicola*

yond. An arborescent species up to 5 m tall, with rod-like branches. The main stems can become massive, the branches so dense that the tree often leans under its own weight, and can do damage when a bough breaks and falls. As it is often cultivated it is uncertain whether its distribution is natu-

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grow up to 2.5 m in height, the leaves fleshy, the terminal inflorescences umbel-like with bisexual cyathia.

Small shrubs

E. rugosiflora Leach [colour p. 108]: Endemic to the Chimanimani Mountains which lie between Zimbabwe and Mozambique. Type collected in the northern sector, on the eastern bank of the Muhohwa River. A dense spiny shrub branching from the base to a height of 400 mm, erect stems simple, segmenting annually, 10-15 mm thick, 3- to 4-angled, becoming 5-angled, spine shields enclose the flowering eye but are not continuous. Spreading spines 4-6 mm long, leaves rudimentary, eventually forming a rough ridge. Inflorescence dark red, with sessile solitary cymes carrying up to 3 cyathia in a vertical manner, these often reducing to one fertile bisexual cyathium. The 5 glands very convex and deeply furrowed, (hence the name, 'rugose' meaning 'wrinkled'). The ovary far exserted but capsule erect at dehiscence. Similar plants were once seen on Mount Zembe in Mozambique but no specimens from there survived. The species had been collected before at the type locality (Wild 1950) but the collection of complete material was by Richards et al in 1988, Dave Richards reporting that the flowering period (apparently erratic) is from April onwards.

E. malevola Leach: Subsp. *malevola* is widely distributed in Zimbabwe. It is related to the vigorous *E. complexa* of the Transvaal. *E. malevola* is a spiny, shrubby plant, branching from the base, the narrow stems 4-angled and up to 1 m high. Subsp. *bechuanica* has been described from Botswana, and is distinguished by its sessile inflorescence, while that of the typical subspecies is shortly pedunculate. Both subspecies have attractively striped, tetra-angled stems, the spines being needle-sharp.

E. dissitispina Leach: Known only from its type locality near Umkondo Mine in the Sabi River valley. A spiny shrub up to 500 mm high, divaricately (widely divergent) and intricately branched; the slender stems 4-angled and 5-8 mm thick. The species is closely related to *E. malevola*, but differs in its smaller dimensions and re-branching habit, and its widely spaced tubercular teeth and spine shields. Its specific name refers to the wide-spaced spines.

E. schinzii Pax [colour p. 105]: Widely distributed

in the Transvaal and Zimbabwe. A spiny small shrublet which forms compact clumps up to 330 mm in height. It has a thickened main root and produces offsets below the soil. The narrow stems are up to 150 mm long, usually 4-angled and, as in the last two species, the tubercles have main and secondary spine pairs.

E. davyi N.E.Br. [colour p. 103]: This dwarf species was first collected near Pretoria, Gauteng, in 1900. It is known in the Waterberg and Marico districts of the Northern Province (Transvaal) and in south-western Botswana. In Zimbabwe it is recorded from Kezi (south of the Matopos and 75 km east of the Botswana border) and several points south of Gwanda. A spineless, fresh-green, dwarf species with its caudex bearing several to many finger-like branches, its habit is typical of the widespread and variable 'vingerpol' euphorbias of South Africa. It has relatively long, conspicuous, linear leaves at the branch tips, but their length is variable. In a land where dwarf euphorbias are a rarity, its presence in Zimbabwe is surprising.

Geophytes

E. trichadenia Pax: A geophytic species which occurs in Angola, Transvaal and KwaZulu-Natal; in Zimbabwe it is widely distributed and common in Kyle National Park. The large underground storage tuber gives rise to several herbaceous branches which bear linear-lanceolate sessile leaves from 18 to 60 mm long, the lowest leaves much shorter, bluish-green in colour. The cyathia have fringed lobes and glands which are fingered and forked at the apex. The name means 'hairy glands' but the glands may be glabrous in this variable long range species.

E. decidua Bally & Leach [colour p. 108]: This interesting and largely unknown species occurs in the Sipolilo and Mount Darwin districts and is also present in southern Zambia and Mozambique. It has a swollen underground tuber consisting largely of storage parenchyma which allows the accumulation of reserve materials. Growth is in two stages: the sterile, aerial branches develop from subterranean buds and are many-angled, tuberculate and deciduous; these branches are later followed by the flowering peduncles. This is apparently a drought adaptation: when the plant is cultivated and watered regularly, it will often produce flowers on the

deciduous branches. Although scarcely present in Harare collections, one farmer is known to have brought in a sack of the turnip-like plants removed when he was cultivating a new land! All of these were exported to other countries.

Also present in Zimbabwe are the Pax species *E. espinosa*, *E. guerichiana* and *E. matabelensis*, as well as *E. transvaalensis* Schltr. but these are woody shrubs and cannot be classed as succulents. In fact the term 'succulent' is sometimes ambiguous; meaning different things to different people; to the writer it is a plant which has succulent leaves or succulent stems (or both) and these should (preferably) be visible. It is obvious that species like *E. trichadenia* do not fit this description, but are included because of taxonomic reasons and popular appeal.

MOZAMBIQUE

Several of the tree euphorbias already mentioned occur in Mozambique; these include *E. confinalis* subsp. *confinalis*, *E. cooperi* var. *cooperi* and var. *calidicola*. Others have their distribution centres in Mozambique.

E. halipedicola Leach [colour p. 107]: Extends along the coastal belt from a few kilometres south of the Save River to Lumbo in the north; it is also recorded from the Chipinga district in Zimbabwe. Along the lower Zambezi River it may overlap the distribution area of *E. cooperi* var. *calidicola* but the two taxa are easily distinguished by the shape of their segments. *E. halipedicola* is a spiny shrub or small tree about 4 or 5 m high, with a stout trunk and branches deeply constricted into oblong segments, the margins of which are undulate. The inflorescence consists of a cluster of up to 6 cymes, each having 3 cyathia. The species is easily recognised when in fruit because of the crowded nature of the ripe capsules.

E. lividiflora Leach: Present in the swampy coastal region often in association with *E. halipedicola*, and in a few scattered colonies in the Chipinga district of Zimbabwe. A succulent tree 4-10 m high with a woody trunk and spreading main branches which produce whorls of secondary branches. The small paired spines are on separate spine shields. Its name refers to the striking cyathia which have dark purple shining glands, the male flowers being almost black.

E. declivicola Leach: Occurs in the Mozambique district between Namina and Nampula, some 700 km north-east of *E. graniticola* to which it is closely related. Unlike the latter which is low-branching, *E. declivicola* is caulescent, up to 3 m tall, with a stout simple trunk, its branches 600 mm long.

E. bougheyi Leach [colour p. 108]: Coastal plain in the Manica e Sofala district: Macuti beach at Beira and further south near the mouth of the Save River. A spiny tree up to 7 m high with a bare cylindric trunk. The segmented branches are usually 3-angled with very thin wings and a hard central core. The ultimate branches are often 2-winged; all wing margins are crenate, wavy with paired spines at the apex of the crenations.

Shrubs

E. graniticola Leach [colour p. 108]: Manica district: in the vicinity of Vila de Manica and Vila Pery. This species is either stemless or, in old plants, exhibits a short grey trunk, attaining an overall height of up to 2 m. The neat 4- to 6-angled branches are up to 1 m long, their segments varying up to 250 mm in length, with a conspicuous white continuous margin. The paired spines are widely divergent and up to 8 mm long.

E. griseola Pax: A few isolated colonies of subsp. *griseola* have been recorded from the Ile Mountains and Mt Zembe, these apparently well aligned with the dark crimson flowering form present in the Chimanimani Mountains. Subsp. *mashonica* which has a many-angled main stem is recorded from Vila Mouzinho and the Zobue Mountains, both localities close to the south-western border of Malawi. (See main entry on this widespread and variable species under shrub-like species with paired spines in South Africa.)

E. baylissii Leach: Coastal sand dunes of the Sol do Save region. An erect spiny species usually single-stemmed or sparingly branched, seldom exceeding 1 m in height. The stem is 4-angled, with a whitish stripe running along the furrow between the angles; the margins are sinuate-toothed. Branches when present spread horizontally, armed with needle-like main spines and a pair of minute prickles. *E. baylissii* is a slender, shade-loving species which is sheltered by the evergreen scrub close to the sea.

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glands yellow and lobes red, the capsule reddish-brown. The name '*perplexa*' indicates a taxonomic problem and Leach relates *E. perplexa* to a number of other species which include *E. tetraanthoides* Pax of Tanzania and *E. cataractarum* Carter, and there are further ramifications. The above applies to the typical variety, and one wonders whether *E. perplexa* var. *kasamana* Leach was ready for publication, coming, as it does, from one collection 'north of Kasamana', being less robust and having fine needle-like spines.

E. luapulana Leach: Masonda Falls on the Luapula River in north-east Zambia. A spiny shrub up to 1 m, branching from the base, the stems 4-angled, mottled green, sinuate along the angles. The plants grow among rocks within spray distance of the Falls, in the vicinity of *Aloe luapulana* Leach. The stems are about 10 mm thick, but narrow at the base to about 5 mm. Spines divergent and up to 8 mm, prickles at the sides of the leaf scar up to 1.5 mm. Cyathia 3, horizontal in position, capsule barely exerted, sessile, reddish at its apex and on its angles. The species distinguishes itself by its bright red capsules and the prickles are almost parallel, while in all related species the prickles are divergent.

E. inundaticola Leach: Present in Mopane woodland in the Luangwa River valley in eastern Zambia. A spiny shrub up to 1 m, branching from the base, often trailing, often with aerial roots from these stems; 4-angled, sinuate on the angles, spines divergent and up to 8 mm, stipular prickles 2 mm long and widely divergent. Inflorescence axillary, the involucre and lobes are yellowish and red-flecked; anthers purplish, capsule borne on a stalk 3 mm long. The species differs from *E. luapulana* and *E. cataractarum* because of its trailing habit and adventitious roots.

E. speciosa Leach: Chisimba Falls in northern Zambia. The name meaning 'showy' alludes to the bright red colour of the flowers. A robust shrublet usually about 300 mm tall (seldom to 1 m) which branches sparingly from a thickish main stem the diameter 20-25 mm towards its somewhat bulbous base. The 4-angled branch stems are bluish-green with a pale winding stripe; angles are crenate, spines up to 8 mm, prickles short, 1 mm. Cymes are shortly pedunculate with 3 cyathia horizontally placed; the glands and lobes are bright maroon-red.

Dwarf species

E. whellanii Leach: In 1962, J.A. Whellan discovered an unusual dwarf euphorbia 32 km east of Abercorn in north-east Zambia. The species is densely branched and less than 100 mm high. It has a cactus-like appearance due to the overall cover of the spidery, fragile spines. The tubercles are usually arranged in 6 vertical ranks, the spine shields separate; on each shield there are 2 pairs of whitish spines of almost equal length, each pair extending away from the other. The funnel-shaped cyathium has fleshy yellow glands. Like several other dwarf Zambian species, it selects shady, damp surroundings.

E. jubata Leach: Central Province: Serenje district: 3 km west of Serenje. A spiny dwarf under 150 mm in height and apparently related to *E. schinzii*. It is only known from the type locality where it grows among rocks in the shade. The species is densely-branched with 4-angled branches which are furrowed between angles and constricted into segments.

E. fanshawii Leach: Northern Province: a dwarf species which is plentiful in damp shade at the Ntumbachushi Falls west of Kawambwa. It is closely related to *E. decidua* of the Sipolilo district in Zimbabwe. Like *E. decidua* it produces short, succulent, spiny branches from a compressed underground stem which merges with the swollen taproot. Unlike the Zimbabwe species, its more prominently tuberculate branches are not seasonally deciduous (but this is a habit dictated by a long dry season) and the flowers are borne on axillary inflorescences on the persistent branches.

E. debilisipina Leach: 3-8 km west of Lusaka on limestone pavement in savannah. A dwarf shrublet branching from the base into clumps, weakly spinescent, these stems subquadrangular, 8-10 mm in diameter, tapering to the base, and about 125 mm high. The tubercles are unevenly swollen and not laterally compressed into winged angles. Paired spines are variable, being absent, or rudimentary, or as long as the paired prickles which are up to 3 mm. The 3 cyathia are placed horizontally with a central deciduous male, the lateral ones bisexual, the involucre yellow. Male flowers exerted in 5 groups, each group subtended by a broad bract; capsule is hardly exerted. This species is probably close to *E. whellanii* and is part of a group which

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is about 40 mm tall; its flowers are borne on slender forked peduncles.

M. mafingense Hargreaves [colour p. 108]: Occurs on the Mafinge Ridge above Mulembe on the Zambia-Malawi border. It is tuberous, the deciduous branches up to 50 mm and prostrate. It is conspicuous when flowering because of its bright red glands, and may well have been in flower when collected by Fanshawe on the Zambian side of the Ridge. Fanshawe is remembered in another caudiciform species, **M. fanshawei** Bally, which also occurs in Zambia, a taller plant up to 300 mm.

Although **Synadenium** Boiss. is a closely related genus, its general habit is far removed from that of

the true succulents and therefore description seems out of place here. In this genus the involucre gland forms a continuous rim, but is sometimes notched. A few of the north African euphorbias show fusion of the glands in this manner. The type species, **S. cupulare** (Boiss.) Wheeler is a shrub with stems succulent but becoming woody; it occurs in KwaZulu-Natal, Swaziland and the Transvaal.

Finally, mention must be made of **Endadenium gossweileri** (N.E.Br.) Leach from the Benguela district of Angola. A monotype, this shallow-rooted species is an unarmed, milky succulent shrub of about 1 m in height. Certain features of its inflorescence preclude its assignment to any of the other genera mentioned in this section.

Apocynaceae and Passifloraceae

Pachypodous plants

1 Apocynaceae

Many members of the family Apocynaceae possess the 2-horned seedpod which is characteristic of the family Asclepiadaceae, and this is only one of several features which indicate the close relationship of the two families. Oleander, Frangipani, Dipladenia and other showy garden plants which belong to the Apocynaceae have been introduced into southern Africa. Milky latex and poisonous alkaloids are present in many of these species which occur largely in the tropical regions of both hemispheres. The interest of the succulent enthusiast in this family centres on the related genera *Adenium* and *Pachypodium*, both of which produce swollen stem forms. These genera are distinguished from each other by the presence of long stipular spines in *Pachypodium* and the absence of this feature on the stems of *Adenium*. In addition, the seeds of *Pachypodium* have a tuft of hairs at one end, whereas in *Adenium* the seeds are bi-tufted.

Adenium Roem. & Schult.

Adenium is a small genus of succulent shrubs occurring in Africa, Socotra and Arabia. Of the 12 species known, only four occur in southern Africa. Although closely related to *Pachypodium*, it is distinct in that the stipules at the base of the leaves are minute or absent, whereas in *Pachypodium* they form long, rigid spines. The flowers are usually showy, in pink, red or purple, sometimes with white, there are 4 very short stamens, the anthers have long terminal appendages, the seed is distinctive with a tuft of hairs at each end.

A. boehmianum Schinz [colour p. 173]: Southern Angola and northern Namibia, at altitudes from 900 to 1200 m above sea level. A succulent shrub up to

1.5 m tall, the swollen stem bearing whitish-grey branches. The leaves are 80-140 mm long, 50-80 mm broad, and folded along the midrib. The showy, pink to mauve flowers have a darker throat and are hairy on the outside; they appear from November to May, usually with the leaves. The sap is very bitter and is still used as a source of arrow poison by the Bushmen.

A. multiflorum Klotzsch [colour p. 173] (*A. obesum* var. *multiflorum*): The most popular *Adenium* and well-known in the Northern Province (Transvaal) and Zimbabwe as the Sabi Star. It has a wide distribution, which includes northern KwaZulu-Natal, Swaziland and Mozambique, where it was first collected at Tete, in the years 1842-1848. The large swollen stem with greyish smooth bark enables the plant to survive long dry periods. The plants can reach very large proportions: in the Zimbabwe lowveld south of Mutare the author found an old specimen which measured 7 m around the base. The showy flowers are white or pale pink with darker pink margins, appearing before the leaves which are 70-120 mm long and 30-80 mm broad. Flowering occurs between May and December.

A. oleifolium Stapf: Restricted to the Kalahari region in the Northern Cape, southern Namibia, southeastern Botswana and western Northern Province. From 120-400 mm tall with a tuberous, largely buried stem up to 300 mm in diameter; this small species can be distinguished by its linear leaves which are 50-110 mm long and only 4-13 mm broad. The inflorescence is terminal and few-flowered. The flowers, pale pink to red, appear with the leaves.

A. swazicum Stapf [colour p. 173]: On sandy flats in the lowveld of Mpumalanga, Swaziland and Mozambique. A small shrub with a largely buried stem 100-150 mm in diameter, producing several green-

*Adenium multiflorum**Adenium swazicum*

ish-white branches with terminal clusters of leaves. The lanceolate leaves are 60-130 mm long and 10-30 mm broad, often folded and softly pubescent. The flowers are pink to deep purple, darker in the throat, and appear with the leaves. The corolla tube is densely hairy outside, glabrous inside the upper part of the tube. *A. multiflorum* overlaps its distribution, but can be distinguished from *A. swazicum* by the inner pubescence in the upper part of the corolla tube, the dark border on the petals, and the grey stems usually bear flowers before the leaves appear.

Pachypodium Lindl.

Pachypodium ('thick foot') consists of about 20 African and Malagasy species, of which five occur in southern Africa. In these five, the stem of three of them is more or less a rounded tuber, subterranean or partly exposed, and in the other two the stem is cylindrical, taking on tree-like proportions. The flowers are 5-merous and showy, in shades of

pink, purple or white. The corolla is tubular and constricted near the base, with the petals of varying dimension. Line drawings of the flowers and the leaves (as well as a distribution map) are given in Piet and Elsa Vorster's well-illustrated account of this genus in *Aloe* 11(3), 1973, and are very helpful in species recognition.

P. namaquanum (Wyley ex Harv.) Welw. [colour p. 173]: This species, more than any other, stimulates thoughts of science fiction fantasy. If one can find a local farmer who knows the way to the 'Half-mens', meaning 'almost human', and then drives along tracks which wind around the sweltering hot hills bordering the Orange River in the north-western Cape, one is eventually rewarded by the sight of a colony of these plants marching over the hills. With slightly bent heads of green crinkled leaves atop rarely-branched spiny stems up to 2.5 m tall, they always turn northwards. In an uncanny manner they are arranged in pairs, or family groups with a young one peering around the thickened stem of a 'parent', or stand alone, like outcasts. The

cylindrical stem which is very hefty at the base, narrows to the top, and is covered with tubercles, each having a pair of stipular spines 30-70 mm long. When in flower from August to October, the plant has a spectacular crown: the long, tubular flowers, yellowish on the outside and wine-red within, nest inside the crisp green head of leaves which later dry out and fall away during the hot summer months. Although the habit alone separates this species from the rest immediately, it is of interest to note that the flowers are very different; the corolla tube is 25-50 mm long, with short, upright corolla lobes quite unlike the spreading lobes of the other four species. Keeping to altitudes from 300 to 900 m, *P. namaquanum* extends into southern Namibia, supported by fog from the Atlantic and a low rainfall of 50-120 mm.

***P. lealii* Welw.:** ('Bottle tree') North-western Namibia and southern Angola. Friedrich Welwitsch discovered this species in southern Angola and described it in 1869; the later described *P. giganteum* is a synonym. The name honours Lt Col Fernando da Costa Leal, the Portuguese cartographer, whose map of Angola greatly assisted Welwitsch in his travels. *P. lealii* forms a shrub or tree up to 6 m

high; the stem, which has a diameter of up to 500 mm at the base, divides into a few narrow, erect branches on which the leaves are terminal and deciduous. There are two kinds of leaves: at flowering time from July to August small leaves about 10 mm long are present which soon fall off, so the flowers appear on bare stems. Later a branchlet appears in the axil of the small leaf and this bears the



Pachypodium lealii in flower



Pachypodium lealii – Cunene River, Namibia

normal leaves which are oblong-lanceolate and 25-80 mm long. The white, sweet-smelling flowers have attractive, spreading, assymetrical petals, the margins of which are smooth on the one side, frilled on the other, and are very similar to those of the eastern, shrubby *P. saundersii*, which is the only other tropical species of *Pachypodium* in southern Africa; the two species are separated by more than a thousand kilometres.

P. saundersii N.E.Br. ('Impala lily'): Extends from northern KwaZulu-Natal along the Lebombo range into Mpumalanga and the Northern Province (Transvaal), southern Mozambique and Zimbabwe, where it is known as the 'Lundi Star'. It is a succulent shrub up to 1.5 m high, with an exposed tuberous stem up to 1 m in diameter which produces several narrow, thorny branches. Unlike the tall *P. lealii*, its main stem is usually wider than high. The sessile leaves are up to 80 mm long, 12-40 mm broad and deciduous in winter. The flowers, which resemble those of *P. lealii*, are white, wax-like and tinged with purplish-pink. Although the leaves of this species are almost glabrous while those of *P. lealii* are finely hairy, the main reasons for the separation of the two species is because of their complete isolation from each other and their marked difference in habit.

P. succulentum (L.f.) A.DC. [colour p. 173]: Widely distributed in the northern, central and eastern karoid regions of the Cape Provinces and in the

western Free State at altitudes up to 1400 m. Both this species and *P. bispinosum* were discovered by Carl Thunberg in the Eastern Cape soon after 1770. *P. succulentum* is a variable species which has been described several times under different names: *P. tuberosum*, *P. tomentosum*, *P. griquense* and *P. jasminiflorum* are synonyms. The last two were revealed by L.E. Codd in 1963 to be forms of *P. succulentum*: *P. griquense* represents the small-flowered form of the Northern Cape and *P. jasminiflorum* is a white-flowered form. The species has a turnip-shaped swollen stem which is half-buried and produces erect branches 200-300(-600) mm high. The linear leaves have recurved margins, are hairy on both surfaces and up to 45 mm long; being less than 10 mm wide they immediately distinguish this species from the other broader-leaved southern pachypodiums, with the exception of *P. bispinosum*. The flowers, which appear with the leaves, are crimson, pink or rarely white, the corolla tube is 10-18 mm long with spreading petals 8-18 mm long. The flowers distinguish it from *P. bispinosum* which has a funnel-shaped corolla tube with lobes 5-7 mm long.

P. bispinosum (L.f.) A.DC.: Almost entirely confined to the Eastern Cape where it occurs in succulent scrub vegetation from near the sea to Graaff-Reinet and Somerset East in the eastern Karoo. Its name is of no special significance since all pachypodiums possess paired spines. As in *P. succulentum* the tuberous stem has a milky latex, and is almost fully buried with a diameter of 100-200 mm, sometimes larger. The leaves are smooth above, rough below, lanceolate with recurved margins, 20-40 mm long and about 5 mm wide. When not in flower, *P. bispinosum* is easily confused with *P. succulentum* which overlaps its distribution. When in flower, *P. bispinosum* is readily distinguished by its wider corolla tube, and the shorter, rounded petals which are only 5-7 mm long. The flowers appear with the leaves from August to December in shades of purple to pink.

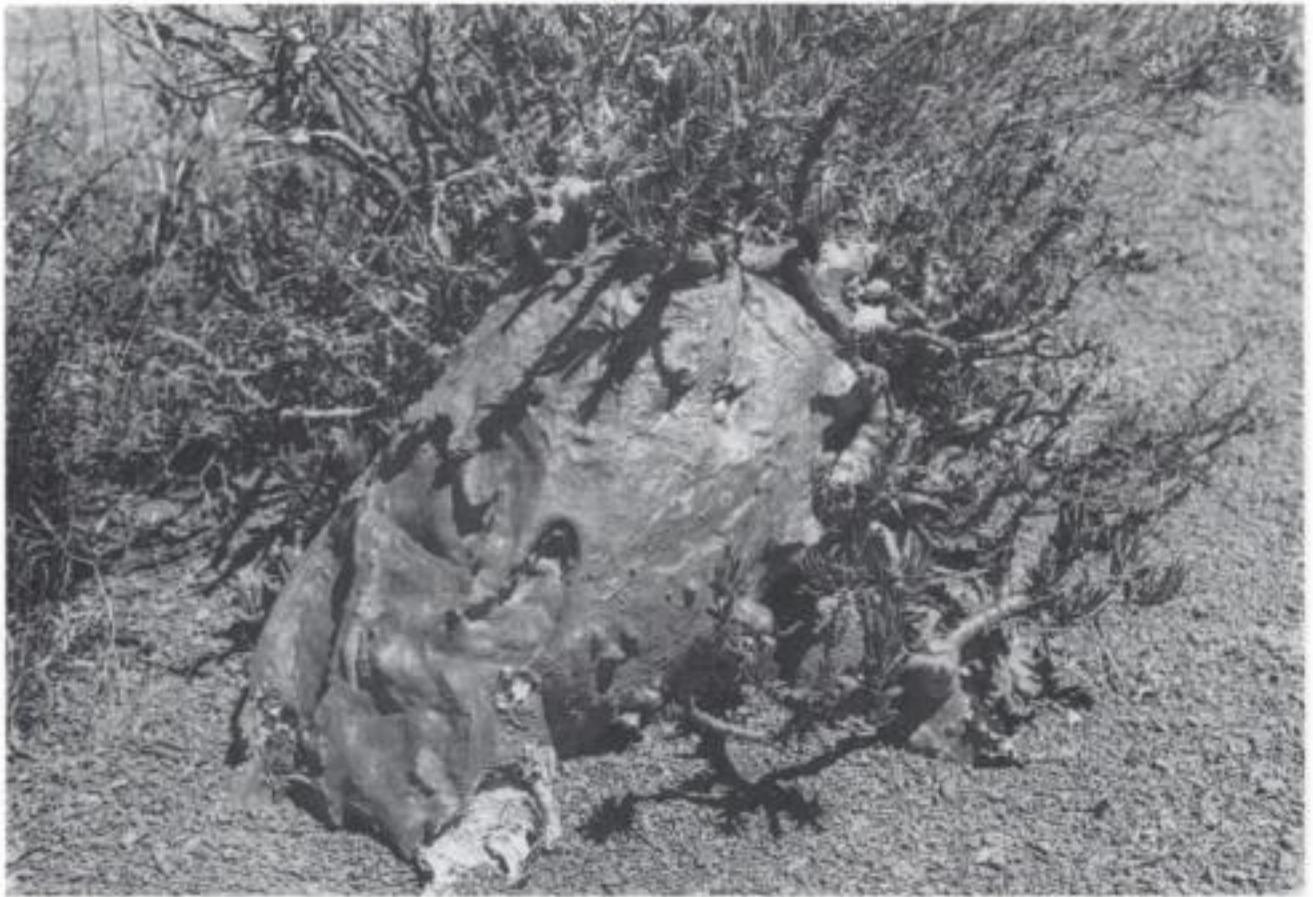
The pachypodiums are quaint at all times and beautiful when in flower. In addition to the southern African species, those native to Malagasy are particularly attractive and tolerant of outdoor culture.

2 Passifloraceae

Also known as the Granadilla or Passion-Flower



Pachypodium saundersii –
Lebombo Mountains, KwaZulu-Natal



Pachypodium bispinosum with large caudex partly exposed

family, it has about 12 genera and about 600 species, cosmopolitan in warm climates. Often climbing with tendrils, some of its members have large, tuber-like stems.

Adenia Forssk.

In his Monograph of the Genus *Adenia* (1971), De Wilde lists 92 species which occur in tropical countries; of these 58 exist in Africa, 21 in Malagasy and the rest are distributed in India and the Far East. More than half of the African species occur in southern Africa, that is, from Angola, Zambia and Mozambique southwards, the most southerly species being *A. gummifera* which extends as far as the Kei River mouth in the Eastern Cape. A common plant with a vigorous trailing habit, it is the only adenia known in the southern Cape. The typical adenia is a sub-woody or herbaceous perennial climber with tendrils, at home in tropical forests where it forms long liana-like stems. It often has a swollen underground tuber or pachypodous stem,

and it is when the latter is situated aboveground that these plants capture the attention of the succulent enthusiast. Like many widespread genera, *Adenia* has adapted to habitats which vary from tropical rainforest to desert; however, the more bizarre southern forms are relatively few in number.

A. spinosa Burt Davy [colour p. 173]: From Pietersburg south-eastwards to Pilgrims Rest in Mpumalanga and northwards to the Soutpansberg and Messina; Zimbabwe: Beitbridge and Gwanda districts. The swollen main stem is irregular in shape, grey or yellowish-green, and can reach proportions of up to 500 mm tall and 2.5 m wide. The branches arising from it easily distinguish this species by having nearly horizontally spreading round thorns 10-40 mm long which sometimes end in a tendril. The thorns arise from the axils of the leaves which are small, simple, heart-shaped, about 16 mm long and which soon drop off. Thorns are rare among the adenias, found elsewhere only in the extraordinary and practically leafless *A. globosa* of Tanzania and the closely related *A. ballyi* of the Somali Re-

public. The thorns are apparently derived from sterile tendrils; in *A. pechuelii* the thorns are the pointed twigs. The cream flowers of *A. spinosa* produce yellowish ovoid fruits about 20 mm long.

A. glauca Schinz [colour p. 174]: Extends from the Potgietersrust district in the Northern Province southwards to the Magaliesberg and Pretoria district; in Botswana it occurs in the Kanye district. An attractive plant with a large, flattish, irregular, swollen stem which is firmly taprooted into the ground. In the rainy season, climbing or spreading narrow branches are produced with compound leaves deeply 5-parted to the base; these branches invariably die back during the dry period. The male and female flowers are both pale yellow; the fruits are roundish, orange and split open into three valves. The widespread *A. digitata* (Harv.) Engl. has a somewhat similar habit, but as its tuber is underground, it is of little interest here. Its frequent recording from Angola, Zambia, Zimbabwe, Mozambique, the Transvaal provinces and northern KwaZulu-Natal is partly due to its notoriety as a deadly poisonous plant; it contains a fast-acting cyanogenic glycoside. A highly toxic albumin known as modeccin has been isolated from the roots of *A. digitata*.

A. pechuelii (Engl.) Harms [colour p. 174]: In Namibia the plants are found on rocky desert soils from the Walvis Bay area to Tinkas and northwards to Omaruru. The most interesting of the southern adenias, this species has an immense grey-green rounded stem up to 1 m in diameter and to 1.5 m tall, almost leafless, producing apical tufts of narrow woody branches which give the plant a hedgehog appearance. The pachypodous stem is firmly anchored in the rocks by its taproot. De Wilde explains that *A. repanda* (Burch.) Engl. is not, as was thought, closely related to *A. pechuelii*, and, in fact, has unremarkable features: its tuber is usually buried and it produces the typical climbing branches which have long, linear, lobed or repand (slightly wavy) leaves, the fruits being a bright coral-red. *A. repanda* is widely distributed from Angola southwards through Namibia and Zimbabwe to the provinces of the Transvaal and the northern Cape.

A. fruticosa Burt Davy: Zimbabwe, Transvaal and KwaZulu-Natal. A shrubby tree in which the swol-



Adenia fruticosa

len stem is flask-shaped and smooth, up to 2 m in height and ending in whip-like branches. There are several subspecies: the typical subspecies has 3- to 5-foliolate leaves and occurs in Mpumalanga and Pietersburg district; subsp. *simplicifolia* has simple or 3-foliolate leaves and occurs in Zimbabwe and the Northern Province; subsp. *trifoliolata* is located in northern KwaZulu-Natal. **A. karibaensis** De Wilde [colour p. 174] which occurs in the Kariba and Sipolilo districts of Zimbabwe has a similar habit, with an unusual, tapering, greyish-green softwooded trunk.

Although the adenias can be grown in large pots, this tends to turn them into 'bonsai' specimens; they are best planted out in the open or under trees where they can achieve their natural habit of climbing. The species of the Transvaal Provinces will tolerate a good summer rainfall.

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Caralluma R. Brown and **Quaqua** N.E. Brown

Caralluma was described by Robert Brown in 1810 to include an Indian species. N.E. Brown in his revisions of Stapelieae in the *Flora of Tropical Africa* and in the *Flora Capensis* (1849-1934) expanded *Caralluma* to include a large number of southern African species and his work was followed in the remarkable account of the Stapelieae by White & Sloane in 1937. First Leach and later Bruyns found the group of diverse elements to be artificial and the splitting into smaller genera began: in 1978 Leach set up *Orbeopsis* and *Pachycymbium* (the latter with only two species), and two species were moved from *Caralluma* to *Orbea*. In 1980 Leach moved two *Caralluma* species into *Tridentea*, a genus split away from *Stapelia*. In 1981 Bruyns placed *Caralluma longipes* and *C. maughanii* in a reviewed *Pectinaria*. In 1983 Bruyns reinstated *Quaqua*, in which 23 species of *Caralluma* recognised in White & Sloane are reduced to 13 species and 11 infraspecific taxa. In 1990 M.G. Gilbert, in a review of *Caralluma* (Bradleya 8), makes 29 new combinations under *Pachycymbium*, plus one new species; with the existing three members of *Pachycymbium* he brings the number of species in *Pachycymbium* to 33. Most of the *carallumas* involved in this shift belong to the northern 'Ango' group, a name coined from *Caralluma angu* of Ethiopia. In 1999 Bruyns revised *Quaqua* to its present assemblage of 19 species. Only *Caralluma peschii* remains as the solitary representative of its genus in southern Africa. There are, in fact, still many *carallumas*, Gilbert (1990) lists 56, but they live in north Africa, the Middle East and India.

Caralluma R. Brown

C. peschii Nel: At Omaruru and Outjo and northwards to the Kaokoveld in northern Namibia. It is stoloniferous, the stems of 8 mm thickness are found at depths of up to 120 mm underground. The aerial stems are extremely narrow, rod-like, 50-70 mm tall and 2-5 mm thick, 4-angled, the angles rounded, with rudimentary leaves tipping the elongated tubercles. The small, shaggy flowers cluster along the upper part of the stem, both buds and flowers pendulous, the corolla, 9 mm across, is glabrous outside, yellowish-green inside with stiff white hairs. Gilbert (1990) refers to it as an anomalous species; he writes that the pollinaria of the species are different to those found in subgen. *Car-*

alluma; this, together with its very disjunct occurrence from the rest raises some doubt as to whether it belongs in *Caralluma*. A very interesting, illustrated account of *C. peschii* is given by Bruyns in *Excelsa* 10, 1982.

Quaqua N.E. Br.

Quaqua is a spiky shrublet, from 50 to 500 mm tall, the stems erect, decumbent or spreading, fleshy and hard, glabrous, greyish, often mottled, the tubercles usually in 4 ranks, tipped with a hardened yellow-brown tooth, stipular denticles present or missing. The glabrous inflorescence is usually on the upper part of the stem, consisting of 1-30 flowers with many bracts on 'peduncular patches' which may produce more flowers the following season; many species are free-flowering. Flowers are small, 7-25 mm in diameter, the corona in two series.

In his 1999 revision, Bruyns places the species in three sections.

1 *Quaqua* sect. *Pseudorhytidocaulon* Bruyns

This section was set up for the single species *Q. pruinosa* which has a distinctive and unusual mode of growth.

Q. pruinosa (Masson) Bruyns [colour p. 175] (*Caralluma pruinosa*): From Garies to Wallekraal in Namaqualand, to Rosh Pinah in Namibia. The greyish or purplish stems are narrow, obtusely 4-angled with small teeth, stems erect and then spreading horizontally to about 300 mm high. It was described in 1892 by Masson who called it the 'frosted *caralluma*' because the nearly black flowers are covered with white hairs. Several inflorescences develop near the tapering stem tips, the corolla is rotate, 7-13 mm across.

2 *Quaqua* sect. *Pauciflora* Bruyns

Species with a spreading growth form, included here are *Q. acutiloba*, *Q. cincta*, *Q. inversa*, *Q. marlothii*, *Q. pulchra*, *Q. bayeriana*, *Q. pallens* (a new species) and *Q. parviflora*.

In most of the 'small-flowered' *quaquas*, there is virtually no corolla tube.

Q. acutiloba (N.E.Br.) Bruyns (*Caralluma acutilo-*

ba, *C. ortholoba*): Widely distributed from Aus in southern Namibia along the western escarpment to Laingsburg, fairly common on flat gravel areas. Much-branched, spiky shrublet 150-200 mm high without stipular denticles and not easily distinguishable unless in flower. The corolla is flat, almost without a tube, glabrous, non-ciliate, 9-14 mm across, variable in colour: solid purple-black, or mottled purple on yellow, or solid yellowish-green. The name refers to the sharp-pointed deltoid corolla lobes.

Q. marlothii (N.E.Br.) Bruyns (*Caralluma marlothii*, *C. simulans*): From Calvinia to Fraserburg in the western karoo, and from Ceres Karoo to Prince Albert. This is a small, distinctive species, the stems decumbent-erect, 50-100 mm tall, forming clumps up to 300 mm in diameter. The stems are acutely 4-angled, becoming mottled violet in the sun. The small flowers appear at or near the stem tips, on long ascending pedicels 3-15 mm long, the corolla 5-6 mm across, the lobes curved downwards and inwards to touch the pedicel, the face of the corolla with brown marks on a pale yellow ground, covered with purple hairs. There is almost no tube, the corona bright yellow; outer lobes erect with bifid tips, inner lobes incumbent on the anthers but not exceeding them. The species is closely allied to the *parviflora-inversa* group.

Q. parviflora (Masson) Bruyns [colour p. 174]: Namaqualand and the karoo side of the western escarpment; Ceres Karoo. Four subspecies in addition to the typical plants are included here. Subsp. *parviflora* (*Caralluma parviflora*, *C. virescens*): on coastal sandveld from Groen River to Alexander Bay, as well as inland to Anenous in Namaqualand. Shade and exposed plants vary from long and scandent to shortly erect, tubercles hard-toothed. The small flowers are held on pedicels 3-10 mm long in a nodding position. Corolla 6-12 mm across, inner surface glabrous, with purplish-red bars on a pale green to white background, lobes spreading-recurved, usually ciliate with purple hairs. Corona stipitate, outer lobes erect with deeply bifid ends widely divergent. Subsp. *dependens* (*Caralluma reflexa*, *Quaqua dependens*) is present in fynbos vegetation from Citrusdal to Klawer. The inner corolla surface is barred, with solid purple towards the end of the corolla lobe, the flowers hang downwards, on fairly short pedicels, with one lobe pressed on the stem, lobes ciliate. Subsp. *gracilis* (*Caralluma gracilis*, *Quaqua gracilis*) occurs on

mountains along the eastern edge of the Ceres Karoo. The inner corolla surface is white with purple-brown marks which may merge, the lobe tips brown or yellow, pedicels ascend and the flowers face upwards. Subsp. *swanepoelii* (*Caralluma swanepoelii*, *Quaqua swanepoelii*): from north-east of Nieuwoudtville to the Hantam Mountains. This form has the shortest pedicels (1-2 mm) in the species, and the flowers lie flat on the stem. The corolla is rotate, 12 mm across, whitish with red to purple disc markings merging into solid colour on the lobes which are spreading with marginal cilia, corona dark purple, the inner lobes rectangular and covering the anthers. Subsp. *confusa* (*Quaqua confusa*) follows the course of the Sout River in Namaqualand. The pedicel is 2-5 mm long and the flower pendulous, corolla 6-12 mm across, dark-spotted on cream, colour merging at lobe tips, corona stipitate, the inner lobes almost equalling the anthers and with an erect dorsal outgrowth at the base. The above four subspecies were all given species status by Plowes (*Excelsa* 16, 1994) but are reduced to subspecies by Bruyns (1999) who refers to them as a 'colour cline'.

Q. bayeriana (Bruyns) Plowes (*Q. parviflora* subsp. *bayeriana*): On the Messelpad south-west of Springbok in Namaqualand. Grey to purple-green stems, 10-20 mm thick. The small pendulous flowers (6-8 mm across) have pedicels 2-4 mm long, the inner corolla cream with reddish-brown markings and thin pale hairs, the short deltoid corolla lobes marginally ciliate. Although surrounded by forms of *Q. parviflora* subsp. *parviflora*, Bruyns reports no intergradation between the two.

Q. pallens Bruyns: A new species from the hills near Garies in Namaqualand. Plants vary from 60-300 mm in height, often scandent in bushes. The stems are slender, only 6-8 mm thick. Flowers insignificant, 4-8 mm across, on ascending pedicels 2-5 mm long. Corolla rotate, glabrous, the disc white with pale green linear-lanceolate lobes which lack marginal cilia, spreading-reflexed. Corona non-stipitate, yellowish-green, outer lobes erect and bifid with divergent ends, inner lobes incumbent on the anthers and meeting at the centre, without basal projection.

Q. pulchra (Bruyns) Plowes (*Q. parviflora* subsp. *pulchra*): A small shrublet 60-300 mm high with erect-decumbent, greyish-green stems, tubercles hard-toothed, up to 10 mm long. Inflorescences at

the stem tips, producing beautiful small flowers, pedicels up to 4 mm long and eventually descending, the flowers facing downwards. Corolla 8-16 mm across, the distal two-thirds of the acute-tipped lobes yellow, with concentric rings of pale maroon around the mouth of the shallow tube, lobes fringed with slender cilia and hairy across their base. Corona about 3 mm in diameter, stipitate, outer lobes ascending and with bifid-divergent tips, the inner lobes incumbent on the anthers, without a dorsal projection at the base. *Q. pulchra* is very similar to *Q. inversa*, but can be distinguished by its hairy corolla face and the absence of dorsal projections on the inner corona lobes.

Q. inversa (N.E.Br.) Bruyns (*Caralluma inversa*, *C. villetii*): Uncommon in widely separate localities from Nuwerus to Port Nolloth. Bruyns describes the flowers as the most beautiful in the genus, this being unapparent as they face downwards. A small plant with erect stems 50-250 mm in height, the stout, conical tubercles hard-toothed and spreading. The pedicel is 2-8 mm long, usually descending. Corolla 10-15 mm across, glabrous, the apical half of the lobes pale yellow or green, the basal half deep red, red-spotted on white in the tube. Marginal cilia on the lobes are flattened, straggling. The corona is reddish, stipitate, the outer lobes notched but not bifid, the inner lobes with a conspicuous dorsal projection. The species is very similar to *Q. cincta*.

Q. cincta (Luckhoff) Bruyns (*Caralluma cincta*): In the vicinity of Springbok; not known from the southern locality given by White & Sloane. Similar to *Q. inversa* but the stems of the latter are more robustly tubercled. The pedicels are 4-12 mm long and ascending so that the beautiful 'girdled' flowers face upwards. Corolla rotate, glabrous, 15-21 mm across, the inner surface dark purple on the lobes, at the centre there are 3 concentric rings of purple on cream, the tube base also cream. Lobes spreading, with flattened vibratile cilia up to 2 mm long. Corona dark purple, shortly stipitate, outer lobes deeply bifid, inner lobes incumbent on the anthers, and with a conspicuous erect dorsal projection.

3 *Quaqua* sect. *Quaqua*

The small flowers are either yellow or white as in *Q. aurea*, *Q. incarnata* and *Q. framesii*, or dark

purple and/or mottled, the corolla lobes often strongly folded back along their length; these include *Q. armata*, *Q. arenicola*, *Q. mammillaris*, *Q. multiflora*, *Q. pillansii*, *Q. linearis* and *Q. ramosa*. Of these, *Q. ramosa* is the most unusual species.

Q. aurea (Luckhoff) Plowes (*Caralluma aurea*, *Q. incarnata* subsp. *aurea*): From Nieuwoudtville towards Calvinia in the western karoo and southwards to the Biedouw valley. Stems decumbent, 50-150 mm high, spreading into clumps up to 300 mm across; sharp-toothed, conical tubercles in 4-5 angles, with paired denticles. Pedicel 2 mm long, the flower with a short, V-shaped corolla tube which subtends the narrow, revolute, ascending lobes which are not ciliate but covered with minute hairs, the outside glabrous. The corolla is 15-22 mm across, white to pale yellow. Corona bright yellow, the outer lobes fused laterally to the inner lobes which are adpressed to the backs of the anthers.

Q. incarnata (L.f.) Bruyns [colour p. 174]: From southern Namibia to the south-western Cape. Subsp. *incarnata* (*Caralluma incarnata*, *Quaqua radiata*): West coast Strandveld from Vredendal southwards to Darling. Stems decumbent to erect, 50-300 mm high, tubercles in somewhat irregular ranks, often with two stipular denticles. Corolla 7-12 mm across, the inner surface cream to yellow, with pale maroon hairs at the base of the lobes. The corolla is campanulate, lobes ascending-spreading, linear-lanceolate, margins reflexed. Subsp. *tentaculata* (*Quaqua tentaculata*) is found in the Knersvlakte along the Sout and Olifants Rivers. Distinct from the other subspecies because of the long narrow corolla lobes, the flower being 12-25 mm across, the tube cupular and twice as deep as the yellow stipitate corona. Subsp. *hottentotorum* (*Caralluma hottentotorum*, *C. ausana*, *Quaqua hottentotorum*) has the widest distribution, from Aus in Namibia to Garies in Namaqualand. A common plant; the greyish-green stems 100-150 mm tall, 4-angled with spiny tubercles spreading or recurved. It flowers profusely along the length of the stem, the yellow corolla campanulate, 12-20 mm across, with short hairs at the base of the lobes. The outer corona lobes are minute and pouch-like. When N.E. Brown first studied this plant he established a new genus, *Quaqua*, from the Hottentot name 'gwagwa' to accommodate it (1879), but later transferred it to *Caralluma*. It is interesting to note

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bifid, pouched; inner lobes adpressed to the anthers and then connivent erect, tips divergent.

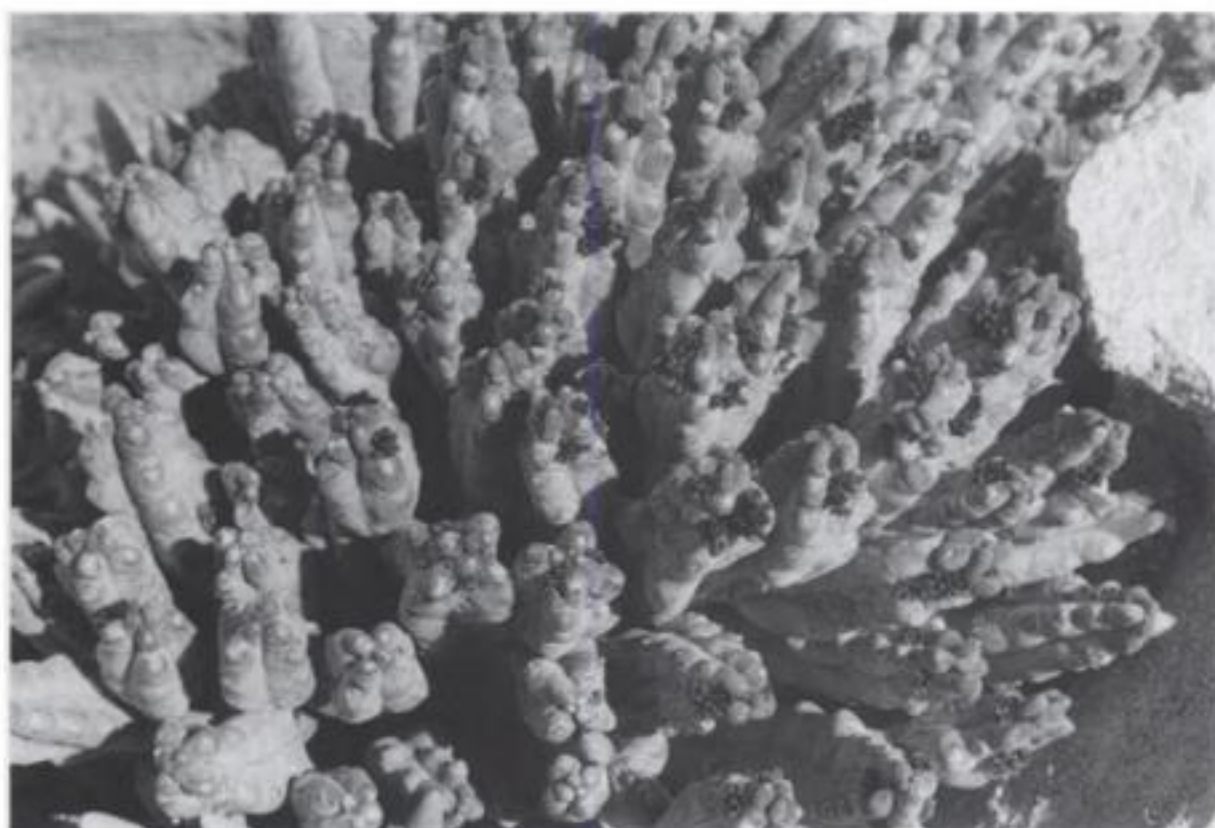
Q. ramosa (Masson) Bruyns (*Caralluma ramosa*): Fairly common in the Little Karoo from Montagu to Oudtshoorn, and in the Great Karoo north of Laingsburg. Probably the most unusual member of the group; the stems which are densely branched are from 60 to 300 mm in height, with rounded, obtuse tubercles which are scarcely toothed. Flowers appear in dense fascicles; the corolla campanulate, small, 13-15 mm long, the inner surface purplish-black on the lobes and to the mouth of the tube, white inside the tube with dark spots; papillate with short white hairs at the tube mouth. Corolla lobes erect-spreading, folded back along their length. Outer corona lobes erect, shortly bifid and pouched, inner lobes adpressed to anthers, meeting at the centre.

Q. albersii Plowes which was described from a single plant (locality west of Vredendal in Namaqualand) is not listed with the *Quaqua* species. Bruyns describes it as being intermediate between *Q. framesii* and *Q. pulchra* and probably a hybrid.

Piarranthus R. Brown

The genus *Piarranthus* was first described by Robert Brown in 1809. It is a distinctive group of stapeliads characterised by a simple corona which lacks obvious outer lobes. White & Sloane listed 16 species in 1937. Investigation by Bayer of collections grown at the Karoo Botanic Garden at Worcester led him to conclude that only seven species could be distinguished in the field, and that further work was required to establish the true relationships of other known variants. U. Meve (in *Bradleya* 12, 1994) presents a well illustrated revision in which he recognises seven species, one of which is a new species, *P. barrydalensis*.

The relationship of the genera *Huerniopsis* and *Piarranthus* must be considered here. White & Sloane (1937) noted that the decumbent growth form and rudimentary denticles at the base of the tubercles of *Huerniopsis* suggested 'some kinship with *Duvalia* and *Piarranthus*', and mentioned the lack of an outer corona in *Huerniopsis*. Meve (1994) describes similarities and differences between *Huerniopsis* and *Piarranthus*, and suggests that the simi-



Quaqua ramosa

lar characters are instances of convergent development. In addition, the two genera are allopatric, with *Huerniopsis* in the summer rainfall area far to the north of the main distribution of *Piarranthus*. The most recent research published is that of P.V. Bruyns: 'The Relationships of *Huerniopsis* and *Piarranthus*' in *Systematic Botany* 24(3): 379-397 (1999). In this paper he shows that the outer corona is present in both genera, if only as a 'U-shaped bay' or ledge (in *Huerniopsis decipiens* and *Piarranthus punctatus*). He gives the results of a cladistic analysis of *Huerniopsis* and *Piarranthus* and draws up a detailed character assessment of both genera. On the evidence shown he transfers *Huerniopsis decipiens* and *H. atrosanguinea* to *Piarranthus*.

Piarranthus is a genus of dwarf plants, with short stems which form mats under bushes. The small flowers which occur in pairs or clusters are usually deeply 5-lobed and most often striped or spotted on a pale ground. It is an excellent prospect for the collector because with careful selection of plants of known origin (not cultivars) it is possible to build up a collection in which all species are represented; this then forms a reference collection against which one can study new variants. According to Meve, *Piarranthus* belongs almost completely to the 'Succulent Karoo Region' and is mainly located in the western and southern Cape winter rainfall zone and the transition zone between winter and summer rainfall. Only *P. decorus* occurs in southern Namibia, northern Namaqualand and Bushmanland. The addition of 2 species from *Huerniopsis* extends the distribution area of *Piarranthus* to just south of 21° south.

In the first five species which follow, the corolla is rotate (petals united in a plane with almost no tube).

P. barrydalensis Meve: In the south-western Cape from Rooiberg Pass in the Koo valley which has renosterbos and fynbos elements to Muiskraal in the Little Karoo. (The Little Karoo actually extends eastwards from Montagu.) The stems are 10-30 mm long, subglobose to cylindrical, green, rudimentary leaves minute. Inflorescence is 1-2 flowered (in October), the flowers 20-26 mm across, the corolla rotate with dark red uneven bands on a whitish ground, and a fruity, foetid odour. The corona is yellow, spotted with reddish-brown.

P. comptus N.E.Br.: Well represented in the Great Karoo of the Western Cape, with only a few rec-

ords in the Eastern Province between Aberdeen and Cradock. Stems 10-50 mm long, subglobose, dark greyish-green, rudimentary leaves about 1 mm. The flower opens flat, diameter about 17 mm, with a sour, rotting fruit smell; the pale base colour is stippled with red dots, or short transverse lines, the surface felted with papillae, the margins with or without a few clavate cilia. It is sympatric with *P. parvulus*, *P. decorus* subsp. *decorus* and *P. geminatus* var. *geminatus*, the latter giving some cause for confusion. Meve emphasises that *P. comptus* is well marked by its permanently compact stem segments which do not elongate (as in other species) and the adaxial surface of its corolla is densely felted up to 1 mm in depth. The corona is yellow, the lobes often spotted with red.

P. decorus (Masson) N.E.Br.: Subsp. *decorus* is the southern element stretching from Bitterfontein in Namaqualand to Matjiesfontein in the Western Cape karoo. Subsp. *cornutus* (*P. cornutus*, *P. pulcher*, *P. mennellii*, *P. pallidus*, *P. ruschii*) extends from Aus and the Great Karas Mountains in Namibia to northern Namaqualand and Bushmanland. The stems are 10-50 mm long, subglobose to cylindrical, with leaf rudiments up to 1 mm. The inflorescence has one to many flowers, the corolla 15-30 mm across, the surface densely felted, the pale yellowish base colour contrasted with reddish dots, blotches and bands. The subspecies are distinguished by the coronal lobes which in subsp. *decorus* are decumbent on the anthers, to slightly erect, and 'strongly furrowed', those of subsp. *cornutus* being erect and with smaller coronal crests, which explains the name, 'horned'. Where the latter character becomes ambiguous, the colour contrast of subsp. *cornutus* can, according to Meve, be relied upon, being much brighter than the typical flowers, and in Namibia the red pattern fades to a plain yellow.

P. geminatus (Masson) N.E.Br.: Var. *geminatus* (*P. pillansii*, *P. disparilis*, *P. globosus*) is present in the Little Karoo (Western Cape) from Barrydale to Oudtshoorn; to a lesser extent in the Great Karoo, and two citings from Willowmore on the Eastern Cape border. In this species the two varieties stand apart not only character-wise but show regional differentiation, which raises the question - why not subspecies? (Rothmaler in *Principles of Angiosperm Taxonomy*, Davis & Heywood, 1963). The stems are 10-60 mm long, subglobose to cylindrical, varying from obtuse to 4-angled. The inflores-

cence is 1-3 flowered, with flowers 15-42 mm across in var. *geminatus*, the colours of the open corolla varying from plain yellow to finely spotted in red on a pale ground, the reddish-brown stronger at the tips of the corolla lobes, the surface felted and margins recurved, the corona yellow, unspotted. While var. *geminatus* is very variable and Meve gives attention to three forms within it, var. *foetidus* of the Eastern Cape appears to be well stabilised. It is located widely in the eastern Great Karoo, extending southwards to Uitenhage, Addo and the lower Fish River valley. Its flowers are 15-30 mm across, the corolla lobes 5-7 mm broad, thus the flowers are generally smaller than in var. *geminatus*, but the corolla lobes are wider. The corolla is fleshy, with pale basal colour and reddish-brown bands which condense at the lobe tips, the corona dark yellow and red-spotted, the flowers with characteristic foetid odour.

P. parvulus N.E.Br. [colour p. 175]: South-western Cape, from the Ceres Karoo to Sutherland and Laingsburg in the southern Great Karoo. Stems 15-50 mm long, subglobose, smooth. The inflorescence has 1-10 very small flowers on pedicels up to 12 mm long. The corolla is pale yellow, rarely spotted or striped, densely felted, the corolla lobes narrow, upright with spreading tips, an overall diameter of 10 mm. The corona is yellow, unspotted, its lobes markedly erect, with the tips bent outwards.

In the campanulate group of *Piранthus* Meve recognises *P. punctatus*, which was first named by Masson as *Stapelia punctatus* in 1796, and *P. framesii* described by Pillans in 1928. The new combinations from *Huerniopsis* are included here.

P. punctatus (Masson) R.Br. [colour p. 175]: From Garies in Namaqualand southwards to the Ceres Karoo, also centred around Calvinia in the western Great Karoo. Stems 10-60 mm long, subglobose to cylindrical. The inflorescence has one to several flowers, pedicels 5-15 mm long. Flowers are 18-28 mm across, with (or without) sweet fragrance, the corolla tube circular from above and campanulate, the tube 6-9 mm across and 6 mm deep. Corolla lobes and tube are white with reddish transverse markings. The gynostegium is roughly circular in outline, the corona yellow, the lobes decumbent on the anthers or somewhat erect. The species can be confused with *P. framesii* which is similar, but has

a markedly angular (pentagonal) corolla tube, whereas the tube of *P. punctatus* is circular. ***P. framesii*** Pillans: Restricted to the western karoo from Loeriesfontein to Calvinia. These plants have been confused with *P. punctatus* in the past. The quickest way to tell them apart is to look at the shape of the corolla tube from above: round in *P. punctatus*, angular (pentagonal) in *P. framesii*, there being a definite central depression at the base of each corolla lobe. If this line of thought is followed, then several of the photographs in White & Sloane (1937) are mis-captioned. Bruyns (in *Syst. Bot.* 24(3): p. 390 fig. 9, C&D, 1999) shows that the two species have very different coronas. The gynostegium of *P. framesii* is broader-based than that of its sister species, the inner corona lobes are short, claw-shaped, bent over the anthers.

P. atrosanguineus (N.E.Br.) Bruyns [colour p. 175] (*Huerniopsis atrosanguinea*, *H. gibbosa*, *H. papillata*): This species has a much smaller known distribution than *P. decipiens*, occurring in eastern Botswana in the vicinity of Gaborone and Lobatsi, and along the western border of the Northern Province from south of Messina to Zeerust in the North West Province. The greyish, purple-marked, decumbent stems form mats; the tubercles set in 4 longitudinal rows, furrowed between, with marcescent rudimentary leaves, and stipular denticles. This is one of the most beautiful of the stapeliads; the flowers, which have a strong foetid smell, open late in the afternoon, fading after about 18 hours; the corolla shallow-campanulate, a rich rusty-red, about 40 mm in diameter. The corolla lobes, which have a definite tuck at their base, are transversely rugose, the tube cupular and thickened at the mouth. The inner corona lobes are 8-10 mm long, incumbent on the anthers, then ascending and divergent, whitish-yellow. The outer lobes are 2 mm long, divided into 2 small flaps; the enclosed nectarial cavity is very large.

P. decipiens (N.E.Br.) Bruyns (*Huerniopsis decipiens*, *Piранthus grivanus*): The main distribution is central in the North West and Northern Cape Provinces of South Africa, from Mafikeng in the north to south of Prieska; it is also present in Botswana and central Namibia. The stems and floral buds of this species are indistinguishable from those of *P. atrosanguineus*. In both, the flowers open in late afternoon and are pollinated by nocturnal moths, the flowers of *P. decipiens* remaining open for about 40 hours. The corolla, which is markedly

more deeply campanulate than in *P. atrosanguineus*, is 20-30 mm across, the inner surface glabrous, sometimes rugulose, brownish-red, mottled in yellow to a greater or lesser extent, the lobes spreading-recurved, with a few vibratile clavate purple hairs on their lower (proximal) margins. The outer corona lobes are about 1 mm long, forming a pouch between the inner lobe bases, the stout inner lobes incumbent on the backs of the anthers, then connivent-erect.

Notechidnopsis Lavranos & Bleck

Notechidnopsis was set up by Lavranos and Bleck (*Cact. Succ. J. (US)* 57, 1985) to exclude two South African species from *Echidnopsis* which occurs in Tanzania and northwards to the Sudan and Yemen. In *Echidnopsis* rudimentary leaves and stipules are present. In *Notechidnopsis* the leaf rudiments are undifferentiated. Both genera have tessellate (sectional, like a mosaic) stems but this was thought to be a convergent character by Lavranos and Bleck, and by Bruyns, who revised *Echidnopsis* (*Bradleya* 6, 1988) and *Notechidnopsis* (*Kew Bulletin* 54, 1999).

Notechidnopsis is a genus of small, non-spiny, procumbent to erect plants, 30-300 mm high, often rhizomatous, tubercles arranged in 6-8 vertical obtuse angles on a rounded stem. Leaf rudiments are not obvious and stipules are absent.

N. tessellata (Pillans) Lavranos & Bleck (*Caralluma tessellata*, *C. serpentina*, *Echidnopsis framesii*, *E. serpentina*): Northern Knersvlakte in Namaqualand. Stems prostrate to decumbent, up to 300 mm long, 9-15 mm thick, slightly rhizomatous; tubercles flat with an obtuse central tooth. Pedicels 3-5 mm long, the small flowers spreading outwards from the upper stem. Corolla rotate, 6-10 mm across, the inner surface reddish-purple, speckled with yellow, covered with setose papillae, lobes slightly reflexed; corona bright yellow.

N. columnaris (Nel) Lavranos & Bleck [colour p. 175] (*Echidnopsis columnaris*, *Trichocaulon columnare*): Richtersveld in northern Namaqualand. Stems erect, columnar, 80-200 mm tall, often rhizomatous and spreading. Easily distinguished from *N. tessellata* by its thicker stems (20-25 mm) and the tubercles which are sharp-toothed. The flowers are 12-17 mm across, corolla face greenish-yellow with reddish spots, covered with setose papillae,

the corolla lobes spreading with apices recurved; corona bright yellow with red marks.

Pectinaria Haw.

The genus *Pectinaria* was established by Haworth in 1819, with *P. articulata* as the type species. The name is derived from the latin, 'pecten', meaning a 'comb' and refers to the many-toothed outer edge of the staminal column. The genus occurs in the dry western karoo from northern Namaqualand to near Montagu in the Little Karoo.

In his review of *Pectinaria* (*Cact. Succ. J. (UK)* 43(2/3), 1981) Bruyns gives the historical background of the genus and divides it into two sections to allow for the inclusion of two species from *Caralluma* in which the corolla tips are not joined, as in the case of *Pectinaria* sensu stricto, but the two species resemble *Pectinaria* in vegetative and staminal column characters.

1 *Pectinaria* sect. *Pectinaria*

Pedicel short and thick, corolla lobe tips joined, inner surface of corolla papillate.

P. articulata (Ait.) Haw. [colour p. 175]: Subsp. *articulata* (*Pectinaria articulata*) is a dwarf plant which is uncommon, present to the north-west of Sutherland and south of Calvinia in the western karoo. The stems are procumbent to ascending, shortly jointed (hence the name), 6-angled, up to 60 mm long and 20 mm thick, rounded, tessellate, the tubercles soft-pointed. The flowers are unmistakable, the corolla lobes joined at centre inside the tube, the truncated, erect flower level at its apex. The corolla is 5-8 mm across, purplish on outer and inner surfaces (yellow in the Calvinia plants), the papillae inside the tube covered with transparent spicules. Subsp. *asperiflora* (*Pectinaria asperiflora*) has the widest distribution of the subspecies, from eastern Ceres Karoo to Matjiesfontein and into the Little Karoo. It is distinguished by its flowers, pendulous on short pedicels, the corolla lobes rising to a conical point where the tips join, not truncated as in the typical subspecies. The outer corolla surface is papillate, the inside purple, covered with columnar papillae which in turn are covered with sharp spicules (read N.E. Brown's entertaining account of this little flower in White & Sloane's *The Stapelieae* 2: 737-740). Subsp. *namaquensis*

occurs from east of Springbok to near Loeriesfontein. The flowers face away from the stem or upwards, yellowish-green (reddish-purple near Loeriesfontein) and, as in the last subspecies, the corolla tips join well above the tube, in a flat conical shape, the lobes broader and the tube almost non-apparent (in Bruyns's drawings, fig. 4, p. 67, 1981). Inside the tube the papillae are spiculate and usually dome-shaped. Subsp. *borealis* from Hellskloof in the Richtersveld also produces upward facing small flowers which are broadly conical (about 7 mm broad), half of this length being tubular; it differs from the nearby subsp. *namaquensis* by its longer tube and the papillae have round-topped spicules.

2 *Pectinaria* sect. *Erectiflora* Bruyns

Pedicel long and narrow, corolla lobes free at the tips, inner corolla surface non-papillate.

P. longipes (N.E.Br.) Bruyns (*Caralluma longipes*): Near and south of Sutherland in the western karoo. Short procumbent or prostrate stems up to 60 mm long, 6-angled, shortly tubercled. The long pedicel (up to 35 mm) holds the flower in a sideways or nodding position, the corolla 8-12 mm across, yellow, spiculate, corolla lobes deltoid-ovate. The corona is orange, the limb of the inner lobes reduced, leaving the anthers exposed.

P. maughanii (R.A.Dyer) Bruyns [colour p. 175] (*Caralluma maughanii*): Widely distributed around Calvinia in the western karoo. Stems decumbent to suberect, up to 80 mm long, 6-angled, tubercles with pointed teeth. Pedicels 5-25 mm long, erect, the flower facing upwards. Corolla 12-16 mm across, mustard yellow on the distal three-quarters of the corolla lobes and reddish-purple on the remainder. Corolla face spiculate but not papillate, the lobe margins folded back along their length. Corona purple-black, the inner lobes covering the anthers, the dorsal projection from the inner lobe finger-like and extending the pectinate ring.

Hoodia Sweet ex Decne. (*Trichocaulon* N.E.Br.)

In his revision of *Hoodia* and *Lavrania* (*Bot. Jahrb. Syst.* 115(2), 1993) P. Bruyns gives an absorbing detailed history of the origins of the first hoodias

known to the world, from *Hoodia pilifera* (then *Stapelia pilifera*) collected by Thunberg and Masson to the later collections of Zeyher, Pillans, Marloth and Dinter. Both genera are notoriously difficult to keep alive unless grown under simulated desert-like conditions and Bruyns describes the futility of assembling large living collections without making dried or spirit specimens of plants of known locality; the poor herbarium records are also due to the difficulty of preparation of a good dried specimen from thick, succulent stems.

In 1937 White & Sloane presented keys to and descriptions of 16 hoodias and 26 trichocaulons. The hoodias have large saucer-like or disc-like flowers, the trichocaulons have modest small flowers.

In the Bruyns revision (1993) *Hoodia* consists of 13 species and several subspecies, divided into two sections. Section *Hoodia* includes all the species formerly in *Hoodia*, except *H. ruschii*. Section *Trichocaulon* contains eight species. The remainder of *Trichocaulon* (the spineless sect. *Cactoidea* White & Sloane) is transferred to the new genus, *Lavrania* Plowes.

Hoodia is found in the arid west of southern Africa. It extends from south-western Angola and Namibia within 100 km of the coast, the distribution broadening in South Africa and crossing the Great Karoo, but never close to the western or southern coastline.

Hoodia is a few- to many-stemmed, robust, spiny erect to suberect succulent shrub with many tuberculate angles. In the modern conception of *Hoodia*, the flowers vary from small to very large, deeply lobed to unlobed.

1 *Hoodia* sect. *Hoodia*

The flowers are large, 25-170 mm across, plate-like to funnel-shaped, obscurely lobed with the lobe tips free, and an expansive disc.

H. gordonii (Masson) Sweet ex Decne. [colour p. 175] (*Hoodia barklyi*, *H. bainii*, *H. pillansii*, *H. burkei*, *H. albispina*, *H. rosea*, *H. langii*, *H. husabensis*, *H. whitesloaneana*, *H. dinteri*): Widely distributed from the Brandberg in Namibia to the south-western Cape and across to Prince Albert; also in the Northern Cape to Kimberley. Often found in colonies in which there is a certain amount of variation; solitary collections from these populations has led to the large synonymy given above. Stems are up to 750 mm tall, 25-50 mm thick, with

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H. pedicellata (Schinz) Plowes [colour p. 175] (*Trichocaulon pedicellatum*): From just north of the mouth of the Cunene River in Angola to south of Swakopmund, in an 80 km wide coastal belt. A distinctive species in which the dwarf stems are weakly spinescent and resemble small maize cobs. A single plant may have up to 20 stems, erect at first, later sprawling, 100-250 mm long, 25-50 mm thick, with up to 20 rows of tubercles, the rows clearly disrupted by the flowering process; the tubercle bristle is soon weathered off leaving an unusual spineless stem which may be blackish in habitat. As in *Hoodia mossamedensis* the flowers have long pedicels (4-12 mm) and adopt a nodding position. The corolla is deeply lobed, the inner surface dark maroon to purple-brown, velvety due to the presence of very fine papillae. The margins of the corolla lobes are folded back.

H. triebneri (Nel) Bruyns (*Trichocaulon triebneri*): Along the Swakop River from west of Okahandja to near Otjimbingwe and northwards towards Karibib in central Namibia. A very spiny species branching freely from base and above, up to 300 mm high, stems about 40 mm thick, with 12-14 deep angles. Tubercles prominent, tipped with spines 6 mm long. Flowers in clusters of 6-12 in the grooves of the upper stem, pedicel short, 3-4 mm long, corolla 11-15 mm across, campanulate, the inner surface almost black, covered with small papillae tipped with a short bristle; the corolla tube about 4 mm deep. Corona purplish-black, outer lobes divided into two lobules which are fused to the inner lobes, the latter incumbent on the anthers and only half as long. The dark flowers are foul-smelling.

H. ruschii Dinter: Known only from the east-facing slopes of the Tiras Mountains in Namibia. The many-stemmed plants may reach 500 mm in width and height, the stems 40-50 mm thick, the tubercles in 22-28 angles, bearing spines 6-8 mm long. Flowers in clusters of 4-10, foul-smelling. Pedicel 2-4 mm long, the corolla 20-40 mm across, widely campanulate, the inner surface reddish-brown, finely papillate, the papillae conical and shortly setose. The corolla lobes are deltoid-acute, spreading with tips recurved, convex; the tube is 6-8 mm deep, with a very small gynostegium at its base. Corona purple-black and similar to that of *H. triebneri*, to which the species is related.

H. flava (N.E.Br.) Plowes (*Trichocaulon flavum*, *T. karasmontanum*): Great Karas Mountains in

southern Namibia; in Bushmanland near Pella, and widely in the central Great Karoo, as far south as Prince Albert. It has become rare due to overgrazing and survives by growing inside karoo bushes. The plants may reach 500 mm in height but are usually smaller, the stems obclavate to cylindric, 20-70 mm thick, with 18-31 irregular angles, tubercles weakly spinescent. This is known as the 'yellow *Trichocaulon*', the inner surface of the shortly pedicellate flowers greenish-yellow and minutely papillate. The united part of the corolla is flat, with no tube, the outstanding feature being the bright yellow corona with its spreading outer lobes which divide into linear horns, those of adjacent lobes meeting and resembling the mandibles of an insect. *Hoodia alstonii* also has yellow flowers but these are more or less campanulate, not flat as in *H. flava*.

H. alstonii (N.E.Br.) Plowes (*Trichocaulon alstonii*, *T. halenbergense*): Exposed among rocks in the Halenberg area of Namibia, on the hills in the lower reaches of the Orange River, and in the quartz mountains of the Pella region in Bushmanland. A many-stemmed, glaucous, spiny shrub which may reach 1 m in height, and about 500 mm in width. The stems are 40-80 mm thick, with about 20 somewhat distorted but quite deeply furrowed angles, the sharp pale spines 8-10 mm long. Clusters of flowers develop below the apex of the stem, the pedicel very short, corolla glabrous on both surfaces, 10-18 mm across, yellow and foul-smelling. The corolla is shortly funnel-shaped, the lobes well defined, 6-8 mm long, about 5 mm broad at base, spreading-ascending. Corona is yellow, the outer corona lobes deeply divided into two erect lobes, with tips divergent-erect, the inner lobes incumbent on the anthers and mostly exceeding them. Bruyns notes that the species produces the smallest follicles in the genus, often 30 mm long.

H. pilifera (L.f.) Plowes [colour p. 175] (*Trichocaulon piliferum*): Subsp. *pilifera* occurs in the Little Karoo from Montagu to Uniondale and on the southern edge of the Great Karoo from Matjiesfontein to Gamka Poort in the Western Cape. The 'ghaap' (vernacular name) has always been eaten by people who live on farms, but the reason for the increasing rarity of this subspecies (and many other succulent species) is the new extensive use made of the veld by farmers who are actively using foothills of mountain fortresses (like the Swartberg) which have always been avoided in the past, and the transition of flat valley areas into dust bowls by the

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Adenium boehmianum (p. 153)



Adenium multiflorum, young plant (p. 153)



Adenium swazicum (p. 153)



Pachypodium namaquanum, flowering in September (p. 154)



Pachypodium succulentum (p. 156)

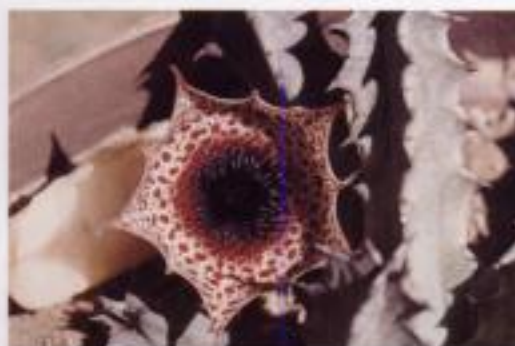


Adenia spinosa (p. 157)

Pachypodium namaquanum, at Rosh Pinah (p. 154)

*Adenia glauca* (p. 158)*Adenia pechuëlii* (p. 158)*Quaqua incarnata* subsp. *incarnata* (p. 162)*Quaqua arenicola* subsp. *arenicola* (p. 163)*Adenia karibaensis* (p. 158)*Quaqua parviflora* subsp. *parviflora* (p. 161)*Quaqua pillansii* (p. 163)*Quaqua linearis* (p. 163)

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*Hoodia dregei* (p. 169)*Lavrania marlothii* (p. 172)*Ophionella arcuata* subsp. *mirkinii*
(p. 182)*Stapeliopsis urniflora* (p. 182)*Lavrania perlata* (p. 181)*Ophionella arcuata* subsp. *arcuata* (p. 182)*Stapeliopsis saxatilis* subsp. *saxatilis* (p. 182)*Huernia clavigera* (p. 183)*Huernia echidnopsioides* (p. 184)*Huernia kennedyana* (p. 184)*Stapelianthus pilosus*, Fort Dauphin,
Madagascar (p. 184)*Huernia kirkii* (p. 184)*Huernia longituba* subsp. *longituba* (p. 185)*Huernia pillansii* (p. 184)



Huernia hislopilii subsp. *hislopilii* (p. 185)



Huernia occulta (p. 185)



Huernia thudichumii (p. 188)



Huernia levyi (p. 185)



Huernia verekeri var. *verekeri* (p. 187)



Huernia procumbens (p. 187)



Huernia oculata (p. 186)



Huernia brevirostris (p. 189)



Huernia pendula (p. 186)



Duvalia modesta (p. 191)



Huernia hallii (p. 189)



Huernia zebrina subsp. *magniflora* (p. 188)



Duvalia pubescens (p. 191)

*Duvalia polita* (p. 192)*Tavaresia barklyi* (p. 192)*Tridentea parvipuncta* subsp.
parvipuncta (p. 194)*Orbea ciliata* (p. 198)*Tridentea gemmiflora* (p. 193)*Tromotriche aperta* (p. 196)*Tromotriche herrei* (p. 197)*Tridentea peculiaris* (p. 194)*Tromotriche longii* (p. 195)*Orbea namaquensis* (p. 198)*Tromotriche revoluta* (p. 195)*Tromotriche longipes* (p. 197)*Tromotriche undausensis* (p. 196)



Orbea variegata (p. 198)



Orbea woodii (p. 199)



Orbea umbracula (p. 200)



Orbeanthus hardyi (p. 201)



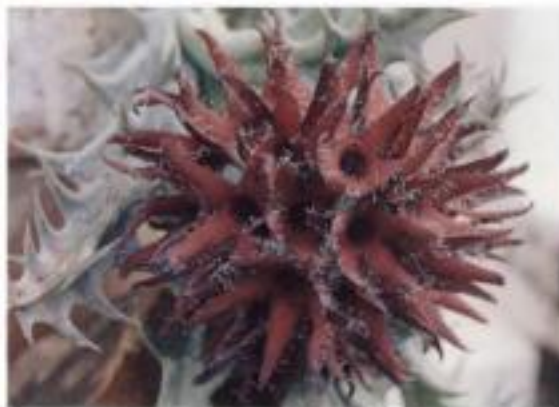
Orbeopsis lutea subsp. *lutea* (p. 201)



Orbeopsis melanantha (p. 202)



Orbeopsis caudata subsp. *rhodesiaca* (p. 202)



Orbeopsis valida (p. 202)



Orbeopsis lutea subsp. *vaga* (p. 201)



Pachycymbium rogersii (p. 204)



Pachycymbium lugardii (p. 204)



Stapelia gigantea (p. 204)



Pachycymbium ubomboense (p. 203)



Pachycymbium keithii (p. 203)

*Stapelia grandiflora* (p. 205)*Stapelia gariensis* (p. 205)*Stapelia unicornis* (p. 205)*Stapelia engleriana* (p. 208)*Stapelia surrecta* (p. 209)*Stapelia acuminata* (p. 209)*Stapelia glanduliflora* (p. 212)*Stapelia schinzii* (p. 208)*Stapelia erectiflora* var. *prostratiflora* (p. 212)*Stapelia scitula* with
Euphorbia burmannii (p. 211)*Stapelia clavicorona* (p. 208)*Stapelia vetula* (p. 207)*Stapelia hirsuta* (p. 206)*Stapelia pruetermissa* (p. 207)

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prostrate, 4-angled stems 40-250 mm long, partly buried with the tips of exposed stems re-entering the ground; tubercles flattened with small teeth near the apex, stipules absent. Subsp. *arcuata* occurs along the Great Fish River valley south of Cookhouse and eastwards to Dikkop Flats near Grahamstown. The flowers are tubular, 4-14 mm long, the narrow corolla lobes joined at the tips, the outside smooth, pinkish-cream, inner surface cream, maroon in the tube. Corona in two series, the outer lobes spreading towards the prominent, knobbed suberect projections behind the inner lobes which are incumbent on the anthers. Subsp. *mirkinii* (*Pectinaria mirkinii*, *O. arcuata* var. *mirkinii*) forms the western distribution from east of Willowmore to near Port Elizabeth. Vegetatively the same as the typical plants, subsp. *mirkinii* is distinguished by its campanulate corolla and the free, erect to spreading corolla lobes.

O. willowmorensis Bruyns: Occurs on steep, north-facing, rocky slopes in the Witteberg north-east of Willowmore. While the stem habit is similar to that of *O. arcuata*, the flowers are different. The flowers are smaller, from 4-7 mm long, and from almost spherical to elliptical, corolla lobes joined at the tips. The outer corolla surface is white and papillate, the inner surface smooth, mottled with deep red on white on the lobes, and with 3 rings of red in the tube; stiff white hairs are present in the tube and lower half of the lobes. The outer corona lobes are slender, pointed, the toothed projections behind the inner lobes spreading horizontally.

Stapeliopsis Pillans

Stapeliopsis was described by Pillans in 1928 for a single unusual stapeliad discovered in the Richtersveld by his wagon driver, Nero. Pillans named it *S. neronis* after him. In 1966 *S. urniflora* from Namibia was described by Lavranos. *Stapeliopsis* is separated from *Ophionella* because of its inner corona; in *Stapeliopsis* the inner lobes are laterally flattened and not incumbent on the anthers but rise high above them.

The review of *Pectinaria* (Bruyns, 1981) revealed that it was an heterogeneous group of species. Bruyns divided *Stapeliopsis* into two sections, moving 4 species of *Pectinaria* into the second section (*P. saxatilis*, *P. pillansii*, *P. breviloba* and *P. exasperata*) with *P. tulipiflora* a synonym and *P. stayneri* a subsp. of *S. saxatilis*.

1 *Stapeliopsis* sect. *Stapeliopsis*

Stems papillate.

S. neronis Pillans: Near Rosh Pinah in southern Namibia, south of the Orange River and east of Port Nolloth in Namaqualand. Stems up to 60 mm long, mottled in green and purple-brown, ascending, described by Lavranos as 'thick, short, square, velvety' in his account of its re-discovery in 1972 (*Aloe* 13(3)). The urn-shaped flowers are wine-red, the outer surface covered with acute papillae, 17-20 mm long and constricted at the mouth to an opening of 1 mm. Downward-directed bristles are present in the lower half of the corolla tube. The most unusual erect, tubular outer corona encloses the whole of the staminal column.

S. urniflora Lavranos [colour p. 176] ('urnaeflora'): Tiras Mountains and in the vicinity of Aus, Namibia. Stems are often stoloniferous and narrower than in *S. neronis*, mottled, minutely papillate, angles rounded and obtusely dentate, rudimentary leaves minute and fugacious. Flowers are small, corolla tubular, 10-15 mm long, easily distinguished from *S. neronis* by the glabrous, shiny outer surface, both surfaces being wine-red, inner surface densely papillate. The outer corona is much reduced and does not enclose the staminal column as in *S. neronis*.

2 *Stapeliopsis* sect. *Cageliorona* Bruyns

This section contains the species moved from *Pectinaria*. The stems are glaucous or brown, glabrous.

S. saxatilis (N.E.Br.) Bruyns [colour p. 176] (*Pectinaria saxatilis*): Very widespread from Vanrhynsdorp in the west to Worcester and the Little Karoo; as far east as Steytlerville in the Eastern Cape. Stems prostrate, semented, often underground, 4-angled with prominent, hard-tipped teeth. Subsp. *saxatilis* (*Pectinaria tulipiflora*) has clusters of plum-coloured tubular flowers up to 16 mm long in which the corolla tips are joined or free, corolla glabrous outside, the inside frosted with spicules, both fine hairs and papillae being present. Outer corona lobes reduced, truncated, the inner lobes rise high above the anthers, the ends bending over them. Subsp. *stayneri* (*Pectinaria stayneri*) is found on riverine slopes within 20 km of the Breede River mouth. It has pale pink flowers which are smaller than those of the typical subspecies.

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tal region, and north-westwards to Vanrhynsdorp. The name 'club-bearing' refers to the clavate purple hairs in the corolla tube and on the disc. The green stems (50 mm) have purple blotches and are 4- to 5-angled. The flowers (30 mm in diameter) are pale yellow covered with papillae and red spots, the latter confluent in the dark red tube. The species is closely related to *H. campanulata* and *H. barbata*.

H. barbata (Masson) Haw.: Mainly Eastern Cape, also in the Free State and Northern Cape, absent from the western karoo. Very similar in habit to the fore-going two species. Short, thick 4-angled stems are acutely toothed. As the name suggests, the flower is densely bearded with purple clavate hairs from the middle of the tube across the disc to the lobe tips, arising from flat, low papillae. The flower with pedicel of about 10 mm long is tubular-campanulate, the corolla varying from 15 to 60 mm in diameter, the inner surface pale yellow stippled with red dots, finely papillate. It is not easy to distinguish *H. barbata* from its close allies; the concentric dark lines in the tube and the length of the corolla lobe being greater than its width assists in differentiating the species.

H. piersii N.E.Br.: Several scattered localities in the Eastern Cape (Sterkstroom to Steytlerville). It has short erect crowded stems up to 45 mm high. Flowers develop successively from a short basal peduncle; the pedicels up to 25 mm long. Corolla campanulate, up to 35 mm across, lobes up to 10 mm long. The inner surface is pale yellow with long spots of reddish-brown, the marks becoming concentric at the mouth; shiny reddish-brown at the tube base. The corolla throat and disc have long stiff dark red hairs arising from papillae; the papillae on the lobes are shorter, and tipped with a globose crimson hair. This species is close to the *campanulata*-complex.

H. pillansii N.E.Br. [colour p. 176]: Mainly Little Karoo, and Matjiesfontein to Beaufort West in the Great Karoo; extending into the Eastern Cape from Willowmore to Steytlerville. Densely tufted many-angled stems which are cylindric to ovoid, each tubercle ending in a soft bristle, rendering its habit unique in the genus. The stems have up to 24 spiral or vertical series of bearded tubercles, the hairs shading the stem and reducing water loss in the semi-desert areas where it grows. This rare feature of a hairy stem also occurs in *Stapelianthus pilosus*

[colour p. 176], which grows far to the north-east in Madagascar. The brownish flowers (30 mm in diameter) have erect, striped, setose papillae on the inner surface, and fairly narrow, tapering corolla lobes.

H. echidnopsioides (Leach) Leach [colour p. 176] (*Huernia pillansii* subsp. *echidnopsioides*, *H. longii* subsp. *echidnopsioides*): Baviaanskloof in the Eastern Cape. Rhizomatous stems up to 3 m long produce small plants at intervals; stems up to 60 mm high, with 7-9 vertical rows of tubercles. Flowers develop at the base of the stem, pedicel 4-7 mm, corolla campanulate, 20-30 mm across, the upper part of the tube densely papillate. The inner corona lobes are erect-convergent, with tuberculate knob-like apices unlike those of the closely related *H. longii*, in which the inner lobes are spreading-divergent at the apex (Bruyns in *Bradleya* 2, 1984, p. 17, figs 2, 3).

H. longii Pillans: West of Uitenhage in the Eastern Cape. Tufted plants found among grasses on steep slopes in the Uitenhage district. It is closely related to *H. echidnopsioides*; the narrow stems (8 mm in diameter) have 6 to 8 rows of tessellate tubercles bearing small teeth when young. The flowers (20-30 mm in diameter) are yellow, spotted with crimson, the corolla campanulate, the whole inner surface densely papillate except in the tube. The erect-divergent nature of the inner corona lobes and the less prominent appearance of the stem tubercles distinguishes this species from *H. echidnopsioides*.

H. kennedyana Lavranos [colour p. 176]: Near Cradock in the Eastern Cape. Unlike most *huernias*, this species is instantly recognisable even when not in flower. It forms a dense mat of stubby, short, 6- to 8-angled globular stems, purplish-green when in full sun, disease resistant and easy to cultivate. The charming little papillose flowers (22 mm in diameter) have several colour forms: cream with red markings, yellow with purple and pale purple throughout.

H. kirkii N.E.Br. [colour p. 176]: At low altitudes in south-eastern Zimbabwe, the Olifants River valley in the Northern Province in South Africa and the border area in Mozambique in the Pafuri region. The short stems are decumbent or sub-erect, marked in mauve and grey, deeply angular and strongly toothed. The large attractive flowers are bicampanulate, corolla 30-50 mm across, pale yel-

low outside, inside cream with a pattern of large and small red blotches, the tube densely papillate in the throat, the papillae maroon and setose. The disc is wide, the 5 broadly triangular lobes with short narrow tips, erect to spreading. (The illustrations for *H. kirkii* in White & Sloane's *The Stapelieae* are, in fact, *H. hislopilii*. The confusion concerning these two species was clarified by Leach & Plowes in the *J. S. Afr. Bot.* 32(1), 1966.)

H. longituba N.E.Br. [colour p. 176]: Subsp. *longituba* occurs in semi-desert areas in Botswana, the western Free State, Northern Cape and the North West Province in South Africa. Small plants under 50 mm high, the stems 4- to 5-angled. The corolla is tubular-campanulate, its whole length up to 28 mm, papillate in the upper tube, the papillae red-mottled; the lobes erectly spreading in line with the tube, the corolla inside creamy-yellow and spotted with purple. Subsp. *cashelensis* occurs in the Melssetter district of eastern Zimbabwe; it has 5- to 6-angled stems, the flowers are smaller and the papillae are bristle-tipped.

H. hislopilii Turrill [colour p. 177]: The typical subspecies occurs on granite outcrops widely in Zimbabwe except in the west; and extends for a short way into Mozambique in the vicinity of Mutare. Stems are 5-angled and strongly toothed. The peduncle is almost vestigial, the pedicel up to 25 mm; corolla 40-50 mm across, tube throat densely papillate with mottled papillae. In contrast to *H. kirkii*, the species has large intermediate lobes (3 mm long), generally reflexed. The corolla tube has an inflated base, and is constricted at the throat, there are dark red circles inside the tube, the rest of the corolla face being creamy with blood-red spots. Subsp. *robusta* is found on dry sandy soils in the west: Gokwe, Lupane, Nkai, Hwange. This subspecies is generally larger and the flowers do not have an inflated base to the tube.

H. occulta Leach & Plowes [colour p. 177]: On granite at Zimbabwe Ruins and Kyle Dam in the vicinity of Masvingo (Fort Victoria) in Zimbabwe. Closely related to the rock-loving *H. hislopilii*, but distinct because it has very slender creeping stems with longitudinal grooves and small teeth and grows in the shade, often completely concealed in the grass. The cream and red-spotted corolla is bicampanulate, the inner surface of the tube is smooth, shiny and blackish-maroon, densely papillate at the mouth, papillae reduced on the disc and lobes. Fig-

ures 1007 and 1008 on page 945 in White & Sloane (1937) captioned *H. hislopilii* are actually *H. occulta*.

H. levyi Obermeyer [colour p. 177]: Caprivi Strip (Namibia), Botswana, Zambia and Zimbabwe. In Zimbabwe the species occurs along the Zambesi and Kafue River valleys, as far as Kanyemba in the east. It has the longest tubular corolla (30-40 mm) of all the *huernias* and it ends in very short lobes; the outside is brownish and ridged, the inside dark maroon, and densely papillose. There is an annular thickening about 5 mm above the base of the tube, possibly to delay the exit of small insects as an additional aid to pollination.

H. whitesloaneana Nel: Discovered by Dr Nel in the Forest Station grounds on the Soutpansberg; also on the Blaauwberg and in areas north of the mountains in the Northern Province. A very small species with stems 4- to 5-angled, less than 50 mm high, strongly toothed. The corolla is campanulate, with lobes spread the diameter is 12-22 mm, lobes 6-8 mm wide, 3-nerved with prominent central nerve; the tube is smooth below, becoming densely papillate towards the throat, the corolla face is cream, spotted in reddish-purple.

H. loeseneriana Schlechter: Mainly in Gauteng (near Pretoria), eastwards to Lydenburg in Mpumalanga, also Potchefstroom in the North West. Short 4-angled stems about 35 mm long form tufts or mats, growing exposed on hilly situations. Flowers with pedicel up to 7 mm long are small, corolla campanulate, 20-26 mm across, rough outside, the inside papillate, dull yellow with crowded transverse marks of brownish-red, the conical papillae extending from the middle of the tube to the tips of the corolla lobes.

H. volkartii Peitsch. ex Werderm. & Peitsch. (*Huernia volkartii* Gossweiler ex White & Sloane): Extending right across southern Africa, from Angola to Zimbabwe Eastern Highlands and Mozambique. It is found on granite or quartz outcrops in areas of relatively high rainfall. The corolla has the rough papillose nature characteristic of *H. stapelioides* and related species. Var. *volkartii* is found in Angola, Namibia and in Zimbabwe where it is known in the Vumba, Chimanimani Mountains and Belingwe. The typical variety has short, slender erect or decumbent stems (50 mm). The yellowish flowers (25 mm in diameter) are marked transversely in red and are densely papillate on the disc

and lobes, the papillae mottled. Var. *repens* from Mozambique and Zimbabwe has long, creeping rounded stems with stem teeth very reduced. The species is probably close to *H. stapelioides* which occurs in thorn scrub whereas *H. volkartii* keeps to higher levels within the mist belt.

H. stapelioides Schlechter: Northern Province and Mpumalanga (Transvaal) and Swaziland. The 4-angled sharply dentate stems (40-90 mm long) form compact clumps or mats. Like *H. hystrix*, the flower (30-42 mm in diameter) is yellow with red markings, but it is less shaggy with much shorter papillae. The outside surface of the corolla is somewhat scabrid, the tube is cup-shaped, wider than long and smooth inside. *H. hystrix* has larger, smooth inner corona lobes, while in *H. stapelioides* they are bristly.

H. hystrix (Hook.f.) N.E.Br.: Var. *hystrix* occurs widely from south-eastern Zimbabwe through Mozambique and Mpumalanga to Swaziland, Kwa-Zulu-Natal and the Eastern Cape. The 'porcupine huernia' is so-called because the lobes and disc of the flower are covered with fleshy, quill-like processes (papillae); the yellow corolla is striped and dotted in red. The spiky 5-angled stems are decumbent and spread over a large area. The long pedicel allows the flower (35-50 mm in diameter) to lie flat on the ground away from the stem. Var. *parvula* is a very small form found only in south-eastern Kwa-Zulu-Natal in Oribi Gorge and Flats. It has much shorter stems, with smaller flowers. The species is a good survivor on open rockeries.

H. leachii Lavranos: South of Vila Pery in Mozambique and near Lake Malawi. The round, prostrate stems are often completely hidden by the grasses amongst which it grows, up to 1.5 m in length, bearing tiny tooth-like leaves. The bell-like nodding flowers are about 17 mm long and 25 mm across; the corolla is bowl-shaped, its surface cream and densely papillate, with concentric rings of purple, and a purple papillate margin. Lavranos named this species in honour of Mr L.C. Leach of Salisbury, who committed himself to many years of painstaking work on the huernias and other stapeliads.

H. pendula Bruce [colour p. 177]: On cliffs along the Bashee River in the Eastern Cape. Stems are pendulous and usually about 900 mm long, but may be longer, rooting when in contact with the ground. Campanulate flowers nodding on pedicels up to 8

mm, most often on new growth of lateral stems. Corolla bowl-shaped, up to 20 mm across, the outer surface light mauve, prominently ribbed, inner surface dark maroon and densely papillate.

H. oculata Hook.f. [colour p. 177]: Widely distributed in northern Namibia and south-western Angola. The most dramatically coloured huernia and one of the easiest to cultivate: in Harare it withstood high humidity levels for three summers without any sign of disease, and flowered at intervals throughout the year. The reddish-green stems (70 mm) are 5-angled and possess spine-like fleshy teeth somewhat like those of *H. verekeri*. Clusters of flowers appear at the base of new growth. The broadly campanulate flowers have a blackish-crimson spreading corolla with a white centre. The corolla is about 20 mm across, with a shallow bowl-shaped central area, both surfaces papillate-asperate. The corona is pale, red-speckled, the inner lobes incumbent on the anthers and meeting above them. In the *Huernia* genus, this is probably the most distinctive species.

H. similis N.E.Br.: Pungo Andongo, Luanda district, in Angola. Stems branching and decumbent to erect, up to 70 mm long, 12 mm thick, almost round, with small vestigial teeth on the obtuse angles. Flowers nodding, pedicel about 6 mm, corolla deeply bowl-shaped or campanulate, 9 mm across the mouth, lobes slightly spreading, only 3 mm long. The outside of the corolla is smooth, inside rough, densely papillate, whitish at the base of the tube, becoming purple above; the papillae at the base are white, becoming larger and purple around the mouth, and reducing toward the lobe tips. The two colours merge, not clearly separated as in *H. oculata*.

H. urceolata Leach: Caimbambo in the Benguela district and Vila Arriaga in the Moçâmedes district in Angola; Kaokoveld in Namibia. This species was discovered in the semi-desert near Vila Arriaga in Angola in 1956 by Dr E.J. Mendes. The 5-angled stems (up to 140 mm) are toothed and have a spiral twist. The 'jug-like huernia' is readily distinguished by its globose corolla tube 8-12 mm long. These are nodding flowers, small, the lobes very narrow and recurving, with prominent intermediate lobes; outside purplish and ridged, inside glabrous, dark purple with an annular white band near the base of the tube. Inner lobes of the corona are swollen, incumbent on the anthers, crimson.

H. verekeri Stent [colour p. 177]: A tufted, tropical, floriferous species with 5- to 7-angled stems (100 mm) closely set with narrow soft teeth up to 15 mm long. Var. *verekeri* occurs in Botswana, Namibia, Zambia, Zimbabwe and Mozambique. The typical variety is an erect, softly-spiked plant which produces an abundance of star-like pale pinkish flowers on pedicels 10 mm long. Corolla is 35 mm in diameter, the narrow corolla lobes up to 14 mm long, the tube white at the base, dark maroon on its circular rim, the corona is suborbicular, the inner lobes incumbent on but not as long as the anthers. Var. *pauciflora* was found by Leach & Bayliss in shade near the mouth of the Save River in Mozambique. It has long, creeping stems with rounded angles and widely spaced smaller teeth, while the flowers occur sparingly at the base of the new branches. Var. *angolensis* occurs in the Huila district in Angola. The decumbent stems lack the strongly toothed angles of the typical variety and the corolla tube is bright red inside. *H. verekeri* is now known to extend from the mouth of the Save River (which enters the Indian Ocean) almost to the Atlantic coastal region in Angola. **H. schneideriana** Berger: The only authenticated collection is from the northern end of Lake Malawi in Tanzania, which area lies outside the scope of this book, but the taxon is included here because White & Sloane (1937) mention its presence in Mozambique, a locality which Leach says is unsubstantiated. The flowers have a strong resemblance to *H. verekeri* but the sepals do not exceed the corolla as in the latter, the rosy-brown corolla lobes are broader, and contrast with the blackish-purple shallow corolla tube. The pale green cylindrical stems have small teeth and may become pendent on lengthening. It has been suggested that the plant may be a natural hybrid, with *H. verekeri* as a possible parent.

H. procumbens (R.A.Dyer) Leach [colour p. 177] (*Duvalia procumbens*): On both sides of the Limpopo River south-east of Messina to Pafuri in Zimbabwe and the Northern Province, and probably Mozambique as well. A fascinating species with reptile-like sinuous stems which grow close to the ground, occasionally lifting their 'heads'. The 5- to 6-angled, almost round stems are pale greenish-mauve, purple in the stem grooves, with small, rudimentary leaves which soon dry and drop off. The plant was first described as a species of *Duvalia* on the strength of its raised red annulus and slender corolla lobes. Later it was transferred to *Huernia* because the corona is 'stalked' with the outer co-

rona resting on the rim of the annulus, and the corolla lobes are replicate to a greater or lesser extent. Although *H. procumbens* has a marked raised annulus it is included here because other features relate it to *H. verekeri*. The trailing stems produce narrow-petalled flowers on pedicels of 15 mm, corolla 40-55 mm across, with maroon annulus, the lobes cream to grey, with red margins and covered with reddish hairs. The corona is seated at the base of a short tube, the inner lobes with a spreading-erect enlarged dorsal wing.

2 Species with a prominent annulus

H. praestans N.E.Br.: From Laingsburg to Vanwyksdorp in the Little Karoo. The very short, purple and green mottled acutely-angled stems (25-50 mm) produce relatively large, showy flowers at the stem base. The corolla (up to 45 mm in diameter) is greenish-yellow, with small purple dots; the raised annulus more heavily spotted, the markings becoming confluent in the tube. The disc has large creamy papillae tipped with stout purple hairs.

H. guttata (Masson) Haw.: The typical plants occur mainly in the Eastern Cape from Somerset East southwards towards Kirkwood and at Uniondale; although variable, they are recognised by their smaller flowers, spotted or lined tube and dull annulus with short inwardly pointed hairs at the tube mouth. The species is small, only 50-70 mm high, the 4- to 5-angled stems with short, deltoid teeth. The flowers have the truly conspicuous, convex annulus which is typical of this group. The corolla is campanulate, with ascending-spreading corolla lobes, the inner face yellow, dotted with crimson, the marks much larger, sometimes confluent on the annulus. Subsp. *calitzdorpensis* occurs in the Little Karoo from Calitzdorp to Oudtshoorn. It is distinguished by its larger, darker flowers, the corolla tube dark maroon with longer clavate hairs at its throat. The colour variation in these beautiful flowers is well shown in a series of photographs by Plowes in *Excelsa* 8, 1979.

H. reticulata (Masson) Haw.: In rocky habitat from Clanwilliam to Citrusdal in the south-western Cape. Robust plants with 5-angled decumbent-erect stems with large deltoid acute teeth. The striking flowers develop from the base, on pedicels 5-15 mm, the corolla 25-50 mm across, campanulate with a broad, shining annulus, the upper part of the

blood-red tube is covered with stiff, glassy purple hairs, the face of the limb and lobes a pale yellow ground colour with large maroon blotches in a reticulated pattern. The broadly deltoid corolla lobes are more or less erect. Leach notes that the 'glassiness' of the hairs in the tube and the tall staminal column are both specific characters.

H. transvaalensis Stent: Near Pretoria (Gauteng) and in the Northern Province, with a single record at Vryburg (North West). The stems form loose clumps up to 100 mm tall covering large areas, the toothed stem angles wing-like. Flowers develop from the base on pedicels up to 25 mm long, the large corolla 45-55 mm across, the tube and shiny annulus unmarked dark maroon, the papillae at the mouth of the tube carrying long purple hairs; lobes spreading-erect, pale yellow with irregular short cross bands of red. Inner corona lobes about 3 mm long, erect with connivent or slightly recurved tips.

H. erectiloba Leach & Lavranos: Nyassa and Zambesia Provinces in Mozambique. Stems 100-200 mm long, decumbent-ascending with strongly toothed angles. Flowers basal on new growth, pedicel up to 20 mm long, corolla bicampanulate, with erect or incurving lobes, asperulous on the outer surface. The tube is about 10 mm long, with a slight constriction midway, shiny and dark red. At the tube mouth there are erect simple hairs, the limb forming only a slightly raised annulus, the corolla face creamy with red markings. Lacking a pronounced annulus, Leach includes the species here because of its obvious connection with *Huernia transvaalensis*.

H. zebrina N.E.Br. [colour p. 177]: A well known species with a wide tropical and subtropical distribution. The former varieties now have the status of subspecies. Subsp. *zebrina* occurs at low altitudes in southern Zimbabwe, Mozambique (Moamba, Maputo), Swaziland, and in South Africa in Mpumalanga and KwaZulu-Natal. The low-growing, 5-angled stems are decumbent-erect, up to 50 mm long, strongly toothed. The corolla is 35-45 mm across, the prominent shiny annulus red to purple-brown, marked or unmarked, the corolla lobes greenish-yellow with red to purple cross-stripes, 'zebra striped'. Subsp. *magniflora* (*H. zebrina* var. *magniflora*) occurs throughout the Limpopo catchment area in the Northern Province, in Zimbabwe and in Namibia. It is a taller, 4-angled form and clump-, not mat-forming. Leach describes it as be-

ing 'more xerophytic', its flowers are twice the size of those of the typical subspecies, up to 85 mm across, but are variable in size and depth of colour.

H. insigniflora Maas (*Huernia confusa*): In the Northern Province east of Pietersburg and from Lydenburg to Ohrigstad in Mpumalanga. The species name meaning 'extraordinary' refers to the striking flowers in which the prominent annulus is deep purple and the spreading lobes ivory to pink. The corolla lobes are unmarked or faintly barred, shortly pubescent. Its stems differ from the related *Huernia zebrina* in being greyish-green with smaller teeth on the angles, and the plants occupy a different habitat, on granite slopes at higher altitudes than the lowveld localities of *H. zebrina*.

H. humilis (Masson) Haw.: A poorly collected species which is not well known. The records are from the Great Karoo: Merweville, Hanover, Richmond, De Aar and Willowmore. The short 4-angled stems taper to the apex in a pyramidal shape, or are globose. The flowers develop from the base on ascending short pedicels (10 mm), the corolla wide-spread and 25-30 mm across. The tube is maroon inside, smooth at the mouth, with a low patterned annulus, darker than the lobes which are yellow with small maroon spots, finely papillate.

H. thudichumii Leach [colour p. 177]: Collected on only several occasions from between Prince Albert and Klaarstroom in the Western Cape. As in the last species, the stems which are erect to 40 mm, are subpyramidal with small teeth. The ivory-coloured flowers have pedicels up to 15 mm, the corolla about 40 mm across, unmarked or with pale pinkish spots. The tube is shallow, the smooth annulus very prominent, the lobes deltate, somewhat convex and recurved, minutely papillate, the papillae forming a thin maroon border on the margins. The species is related to *H. humilis* of the Great Karoo.

H. plowesii Leach: First described in the 1988 revision, (as was *Huernia thudichumii*), this species occurs in the Tiras Mountains south of Helmeringhausen in Namibia. The plants form small clumps, the short stems 4-angled, acutely toothed and almost pyramidal in shape. Flowers with short pedicels, the corolla 25-35 mm across, the tube pentagonal, purple-brown, the annulus very prominent, about 5 mm high, solid purple-brown with a few yellowish marks on its outer edge, with long stiff

hairs scattered in the tube throat and on the annulus. Corolla lobes are spreading, cream with rather distant maroon spots, finely pubescent.

- 3 The remaining eight *Huernia* species which have a widely scattered distribution in South Africa and Namibia are placed by Leach in a group which he calls Section *Fallacistelma* (a name meaning 'misleading corona'). The section does not have a description nor does it possess an overall key character

H. brevirostris N.E.Br. [colour p. 177]: An Eastern Cape species which is variable to the extent that White & Sloane in 1937 recognised eight varieties, using the characters of degree of annulation of the disc and colouration of the corolla face to distinguish them. Leach describes the typical plants (from Graaff-Reinet to Willowmore and associated with the Sundays and Groot River valleys) as having 4- to 5-angled stems up to 50 mm long, 15-20 mm thick, with acute small teeth; flowers with pedicel up to 25 mm, corolla 25-40 mm across, with a shallow bowl, sometimes annular, and an 'overall reddish-brown appearance, due to the heavily spotted corolla and lined tube'. The outer corona has five black deeply bifid spreading lobes, the inner corona lobes connivent above the anthers. Leach selects subsp. *intermedia* (*H. brevirostris* var. *intermedia*) to represent all eight of the varieties accepted by White & Sloane, and distinguishes it by the reduction of corolla markings which leaves the corolla face a yellowish colour, the flowers being somewhat smaller, in contrast to the brown corolla face of the typical plants and his new subsp. *baviaana*. Subsp. *intermedia* is described as having a low annulus and is variable in nearly all characters. Leach locates this taxon in the Cradock-Pearston area, and again mentions the Sundays River, which means there is a distributional overlap and one wonders why var. *intermedia* was elevated to subspecies level. He also finds that near Cradock subsp. *intermedia* is similar to *H. thuretii* var. *primulina* which also has an Eastern Cape distribution and an unmarked yellow corolla face. Thirdly, subsp. *baviaana* occurs in Baviaanskloof, from Willowmore in a south-eastern direction. It is apparently separate and characterised by its curving, widely divergent inner corona lobes, the outer corona lobes whitish; it also has a darker, densely spotted, papillose corolla face.

H. namaquensis Pillans (*Huernia herrei*, *H. owam-*

boensis): A Richtersveld species with some doubt as to whether it occurs in Namibia. The decumbent-erect stems are 4-6 angled, up to 60 mm high, green to purplish-green, the teeth usually decurved and tipped with a persistent hard white point (rudimentary leaf) and with conspicuous axillary buds. Pedicel up to 15 mm, flowers tending to nod, corolla 20-25 mm across, the face pale yellow with reddish spots or marks, the corolla tube markedly constricted and densely papillate at the mouth. The outer corona with 5 deeply bifid or dentate lobes, the inner corona lobes connivent above the anthers, but short. The species is variable in flower size and shape.

H. hallii E. & B.M.Lamb [colour p. 177] (*Huernia namaquensis* subsp. *hallii*): South of Aus and near Grünau in southern Namibia. A very dwarf species with 4-angled pale green toothed stems 15-25 mm long, freely flowering over a long period. The inflorescence is placed near the base or on the side of the stem, the pedicels up to 30 mm long, the pale flowers nodding or supported by the clustered stems. Corolla 25-30 mm across, lobes erect to wide-spread, cream-coloured and finely maroon spotted throughout, the lobes having a fine maroon margin; the tube is smooth inside but papillate at the throat, the papillae conical and minute. The pale, fresh green stems and pallid flowers are diagnostic here.

H. quinta (Phillips) White & Sloane: Located in the Northern Province and Mpumalanga (Transvaal). It has chunky, greyish-purple stems which often twist, up to 50 mm tall and 25 mm wide. The flowers (25-30 mm across) have a short tube with a wide mouth (9 mm), which is surrounded with bristle-tipped papillae. The tube and disc are banded in dark red, the lines often pentagonal, the pale lobes being unmarked and papillate. Var. *blyderiverensis* was set up by Leach (1988) for plants in the vicinity of Blyde River near Ohrigstad. These are distinguished by the spotted (not transversely striped) larger corolla, and the papillae are not bristle-tipped as in the typical variety.

H. nouhuysii Verdoorn: Wyllie's Poort in the Soutpansberg, Northern Province. The stems are 4-6 angled, 80-200 mm high, spirally twisted, deeply and sharply toothed on the angles. The campanulate flowers are in clusters on the stem, pedicels 5-15 mm long, the inner corolla surface greenish and transversely striated with brownish-red joined and broken lines, the corolla with a pronounced pen-

tagonal face, the lobes deltate, spreading, the whole inner surface conical-papillate, especially in the upper tube, the larger papillae with a red mucro.

H. witzenbergensis Luckhoff: A single collection was made on the lower slopes of the Witzenberg Mountains in the Tulbagh district of the Western Cape; the species has not been rediscovered. A remarkable record of a single plant discovered by Carl Luckhoff. Although it bears some resemblance to *Huernia brevirostris* it was found far west of the area in which the latter occurs, and is entirely distinct in its unusual and dramatic colouring: the tube and papillate disc are sulphur yellow, the papillate corolla lobes are dull black. The pedicel is 15–20 mm long, the corolla about 40 mm across, papillate over the entire surface but smooth in the lower tube. The outer corona of spreading unjoined lobes is crimson, the inner lobes yellow, connivent-erect.

H. thuretii Cels (*Huernia inornata*, *H. striata*): Essentially an Eastern Cape species, var. *thuretii* extends from Port Elizabeth to Queenstown and is common around Grahamstown. The case of the completely disjunct *Huernia striata* (synonymised here) in the Tiras Mountains of Namibia needs to be investigated again. A small species that grows in crowded patches up to 50 mm high in rocky situations. Pedicels up to 25 mm long, the flowers less than 25 mm in diameter, the inner surface cream with transverse broken concentric markings in pinkish to brown, the markings usually continued into the tube. Var. *primulina* (*Huernia primulina*) also ranges from Port Elizabeth to Queenstown, and northwards to Cradock where it is located close to *H. brevirostris* subsp. *intermedia* (see note under *H. brevirostris*). Var. *primulina* is distinguished from the typical plants by its lack of markings on the corolla face and the tendency toward a low annulus (a feature of *H. brevirostris* subsp. *intermedia*).

H. bayeri Leach: In the vicinity of the Kouga, Groot and Gamtoos Rivers in the Eastern Cape. The 5-angled stems are 30–60 mm tall with deltoid teeth. The flowers have erect pedicels up to 35 mm long, the corolla campanulate, 25–30 mm in diameter, with well-marked intermediate corolla lobes. The corolla inner surface is cream to pinkish and is rarely marked with transverse lines; the surface asperous, papillate at the throat of the tube, the papillae each bearing a long stiff white hair up to 2 mm long, these papillae becoming reduced on the

disc which is often annular. The corona is dark purple, the outer lobes bifid, the inner lobes about 3 mm long, connivent above the anthers, becoming widely divergent.

Duvalia Haw.

The genus *Duvalia* was established by Haworth in 1812 in honour of Henri Auguste Duval, a French botanist. Much later, N.E. Brown at Kew (1873–1934) recognised *Duvalia* as a natural group and the modern shape of *Duvalia* emerged with diagnostic characters of the annulus and stipitate corona laid down. White & Sloane (1937) followed Brown's concepts. Bayer (1977, 1984) who knew the plants at first hand suggested a reduction in the number of species. In 1990 Meve & Albers subdivided the genus into sect. *Duvalia* and sect. *Arabica*.

In 1997 Ulrich Meve revised *Duvalia* (*The Genus Duvalia*, Springer Verlag, Vienna) in which he treats *Duvalia* under sect. *Duvalia* (13 species, southern Africa) and sect. *Arabica* (4 species) in north-east Africa (around southern Red Sea, Gulf of Aden, Ethiopia and Somalia). The great geographical gap between the two sections ends with the widespread *D. polita* which extends from Angola and Malawi southwards to South Africa. The highest concentration of southern *Duvalia* species is in the Eastern Cape of South Africa. Another centre of diversity is the Little Karoo, with a few species spreading northwards to the Northern Cape, Free State, Namaqualand and Namibia.

Duvalia is a dwarf plant, 4- to 6-angled with small denticles (called stipular glands in the Meve revision) on the stem teeth; the corolla lobes are usually ciliate and (with a few exceptions) severely folded back or replicate; the outer corona is disc-shaped and settles on the inner rim of the annulus. While the corona of *Duvalia* is stalked, in the related genus *Huernia*, the corona is sessile.

In the following account, Meve's revision of the southern African species (sect. *Duvalia*) is adopted.

Duvalia sect. *Duvalia*

D. angustiloba N.E.Br.: Endemic to semi-arid flat country between Beaufort West and Aberdeen in the southern Great Karoo. The densely tufted stems

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shaped annulus with sides sloping towards the base of the expanded lobes which are up to 14 mm long, replicate towards their tips, margins ciliate; the lobes shiny dark red, paling to red on the annulus, then pale rose as it meets the white flattened top of the annulus. Corona cream, coronal disc about 5 mm wide. It meets *D. modesta* in the wild but, according to Meve, does not interbreed.

D. maculata N.E.Br. (*D. minuta*): In the lower Great Karoo from Fraserburg to Somerset East, in the Northern Cape from Kenhardt to Hopetown, Free State and Namibia. Stems ovoid to cylindrical, acute leaf rudiments 2-3 mm long, stipular denticles small. Easily recognised by the flowers, 1-8 at the stem base, reddish-brown corolla 15-20 mm across, the annulus distinctively large, 5-8 mm in diameter, with a raised, undulating rim higher than the coronal disc, cream, speckled in reddish-brown. The corona is yellow, the pollinia green. The species is present in open karoo or grassland, and often with *D. corderoyi*.

D. immaculata (A.C. Luckhoff) Bayer ex Leach: Found along the coast from the Breede River to Little Brak in the Western Cape. This species has an enlarged annulus similar to that of *D. maculata*, 8-11 mm across with rounded, undulating rim, completely dwarfing the sunken corona, uniformly chocolate, without markings. Corolla 20-30 mm across, dark chocolate, dull, lobes replicate and, apparently, without cilia.

D. parviflora N.E.Br. Essentially of the Little Karoo, uncommon near Ladismith and Oudtshoorn. The stem segments are globose, 10-15 × 10-15 mm, with minute leaf rudiments and stipular denticles. A miniature species which produces an abundance of tiny 'colourpoint' flowers, with pedicels 3-8 mm long, cream with lobe tips brownish-purple, lobes 3-6 mm long, furrowed along their length. The species seems to be isolated from the rest in this genus.

D. corderoyi (Hook.f.) N.E.Br.: Great Karoo from Beaufort West to De Aar and southwards to Cradock. Stem segments 12-30 × 12-25 mm, round to ovoid, 6-angled with small leaf rudiments and stipular denticles. The flowers at 50 mm in diameter are the largest of the southern African duvalias and have a strong bad odour. Pedicels 15-25 mm long, corolla dull olive-green to reddish-brown, lobes 12-16 mm long, replicate at their tips but ex-

panded at their base with vibratile, clavate marginal hairs. The annulus is densely hairy, 10-15 mm across and up to 4 mm deep.

D. polita N.E.Br. [colour p. 178] (*D. polita* var. *transvaalensis*, *D. transvaalensis* var. *parviflora*, *D. polita* var. *parviflora*): The 'polished duvalia' is widely distributed in savannah regions of Angola, Zambia, Malawi, Zimbabwe, Mozambique, Botswana, Namibia and South Africa. Stems are rhizomatous, measuring 20-100 mm above and below ground, decumbent or erect, 6-angled with fleshy, spine-like rudimentary leaves up to 6 mm long, stipular denticles well developed. Pedicels up to 25 mm long, corolla 20-35 mm across, reddish-brown, to purplish-chocolate with a high gloss, or yellowish-green spotted with these colours. Corolla lobes rising with tips higher than the annulus, margins ciliate with very long clavate hairs; annulus spotted or unspotted. The species is variable but does not warrant infraspecific taxa (Meve, 1997).

Tavaresia Welw.

This genus was established in 1854 by Dr Friedrich Welwitsch, an Austrian physician and botanical explorer, for *Tavaresia angolensis* which he had discovered in Angola. Unfortunately, the superfluous name *Decabelone* was extensively used for a while but there is no doubt that *Tavaresia* is the correct name for this genus.

The genus consists of two species distributed in tropical and South Africa. These are closely related: both *T. angolensis* and *T. barklyi* have tubular flowers in which the outer corona has long threadlike lobes which end in knobs.

T. angolensis Welw.: Occurs in the arid desert coastal region of Angola from Ambriz to Moçâmedes. One of the synonyms of this species is *Stapelia digitaliflora*, or the 'Stapelia with foxglove flowers' – an apt description of its tubular, deep-throated flowers which are pale yellow and spotted with purple-red. The corolla tube varies in length from 40 to 75 mm. The stem tubercles each have a central spreading spine and two shorter lateral spines pointing upwards.

T. barklyi N.E.Br. [colour p. 178] (*Tavaresia grandiflora*): Has been recorded from the Huila district in Angola; Botswana; Hwange and Beit Bridge area in Zimbabwe; Namibia; the Northern Prov-

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is therefore questionable that a subspecies is upheld on the grounds of corolla colour; degree of campanulation of the corolla is, in this instance, also a weak character. In the western Namibian plants the corolla is pale yellow, with only the upper half of the corolla lobe reddish-black; these are presently referred to subsp. *albipilosa*. The typical flowers are up to 75 mm across, densely papillate and light yellow around the funnel-shaped central depression, the colour changing to purple patches and finally velvety-black on the lobes which are ciliate with long white clavate hairs. In all, a dramatic colourpiece, with a 'horse manure' odour. The outer corona lobes are 3-lobed, the central lobe longer, the laterals thin and tapering.

T. virescens (N.E.Br.) Leach (*Stapelia virescens*): Widely distributed in the central Great Karoo area from Prieska and Hopetown southwards to Beaufort West. According to Bruyns (1995) the species occurs in the northern Eastern Cape. It is extraordinary that Leach thought it necessary to draw a list of differences between this species and *Stapelia flavopurpurea* which has superficially similar small, starlike flowers, and is different in a host of other characters. *T. virescens* has the typical *Tridentea*-type spreading leaves, up to 10 mm long, deciduous on the older stems; the stems are erect, glabrous and 50-100 mm tall. The small, yellowish-green glabrous flowers (25 mm across) are densely covered by large papillae which are apically setose and fused into ridges; the deeply cleft corolla lobes give the flowers a starlike quality. The flowers are borne on pedicels up to 60 mm long and have a very unpleasant odour; the outer corona lobes are deeply trifid.

T. peculiaris (Luckhoff) Leach [colour p. 178] (*Stapelia peculiaris*): From west of Loeriesfontein in the western karoo to the Knersvlakte in Namaqualand. It is obvious that this species is somewhat out of place here with its 'softly textured' stems, sometimes rhizomatous, and with minute leaves. The inflorescence is glabrous, the pedicel up to 25 mm long. The flower is 30-40 mm across, the lower (abaxial) surface glabrous, the upper surface minutely papillate and patterned in brown or purple on a yellow or greenish ground. The corolla surrounding the corona is thickened like an annulus, the corolla lobes ciliate with very short, purple clavate hairs. The outer corona lobes are tridentate and rest on the thickened disc.

The remaining three species held in *Tridentea* have variable outer corona lobes which are not tridentate, the face of the corolla is maculate.

T. jucunda (N.E.Br.) Leach (*Stapelia jucunda*): A widespread and variable species extending from Namibia to the western, northern and central karoo. The typical plants are obtusely angled, glabrous, with widely spreading leaves about 5 mm long. Pedicels are up to 30 mm long, the flowers 20-35 mm across, the corolla face cream-coloured, spotted evenly throughout in purple-brown, with a solid purplish border on the recurved lobes which are generally ciliate with purple hairs. Var. *cincta* (without marginal cilia) and var. *dinteri* are reduced to synonymy under *T. jucunda* by Bruyns. The corolla is glabrous on both surfaces, the outer corona lobes are not tridentate but extremely variable, particularly in Namibian material, varying from truncate to acute or deeply lobed; the inner corona lobes are connivent-erect to about 4 mm, tips recurving.

T. parvipuncta (N.E.Br.) Leach [colour p. 178] (*Stapelia parvipuncta*): This species lies well to the south of the two related species, *T. jucunda* and *T. dwequensis*. Leach's varieties are elevated to subspecies: subsp. *parvipuncta* extends from Laingsburg and Prince Albert to Beaufort West in the Western Province karoo; subsp. *truncata* lies in the Ceres Karoo and Doring River valley. The plants have erect, glabrous stems 60-80 mm long and are similar to *T. jucunda* but the leaves appear to be shorter, rudimentary (White & Sloane, 1937). The inflorescence develops low down with pedicels up to 60 mm; flowers have a central depression, the disc fleshy but not annular, completely fine-spotted in purple-brown on greenish-yellow, the lower surface pale green and also spotted; corolla lobes broadly ovate, somewhat recurved, sometimes with purplish margins, ciliate. Corona raised, the outer lobes spreading, conspicuously bilobed, inner lobes incumbent on the anthers, not erect as in *T. jucunda*. Subsp. *truncata* (*Tridentea pusilla*) varies only in possessing outer corona lobes which are truncate (but show some degree of apical indentation in both Leach's and Bruyns's drawings).

T. dwequensis (Luckhoff) Leach: Widespread in the arid Great Karoo from Brandvlei and Britstown southwards to Fraserburg in the Northern Cape Province. The species was discovered in the Ceres Karoo but has not been rediscovered there. The

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somewhat thickened at the centre is up to 25 mm across, rugulose, glabrous, yellowish to light brown, lobes conspicuously ciliate in purple. The unique feature of the species is the shiny black corona in which the outer lobe has two carunculate (having fleshy outgrowths) heads, or knobs; the inner corona lobes have two horns, both of which are carunculate. White & Sloane (1937) described the effect of the 20 knobbly coronal heads as "the quintessence of the *Caruncularia* strain". In the Bruyn's classification the species is placed in the *Tromotriche* Section.

T. choanantha (Lavranos & Hall) Bruyns (*Tridentea choanantha*): Huis River Mountains and Rooiberg in the Little Karoo. The plants grow on narrow ledges on vertical cliff faces, with roundish, grey, pendent stems 100–300 mm (up to 2 m long). Apparently, each stem flowers only in its early stages; traces of the flowers appearing only on the first 30 mm of stem. The funnel-shaped glabrous corolla is somewhat reminiscent of *Huernia*; the corolla is reddish-purple inside, with erect to horizontally spreading corolla lobes only 6 mm long. Although it was placed in the genus *Stapelia*, the authors, Lavranos & Hall, suggested that it would be better classified in a section of its own. It has an interesting taxonomic history: in 1965 Dyer renamed it *Stapelianthus choananthus* (*Stapelianthus* was set up by Prof. Pierre Choux in 1933 for a very interesting group of stapeliads native to Malagasy); in 1968 the problematic plant was returned to *Stapelia* by Rauh & Werthe; in 1978 Leach placed it in a new category – that of the genus *Tridentea*; it is now moved to *Tromotriche* by Bruyns. The corona is narrowly erect; the outer corona lobes are 3-dentate, but the middle tooth is very reduced; the inner corona lobes are about 5 mm long, terete, becoming filiform.

T. baylissii (Leach) Bruyns (*Stapelianthus baylissii*, *Tridentea baylissii*, *T. baylissii* var. *ciliata*): Baviaanskloof and Kouga River gorges in the Eastern Cape. It is closely related to *T. choanantha* but has shorter flowers produced along the length of the minutely dentate quadrangular stems which grow from crevices in sheer rocky cliffs and are pendent to a length of one or more metres. Unlike *T. choanantha*, scars of old peduncles are visible along the entire length of the stem. The campanulate flower (12–15 mm long) is glabrous and reddish-purple inside; a median groove runs from the base of the tube to the tip of each lobe. *T. baylissii*

has a rugose inner corolla surface opposed to a smooth inner surface in *T. choanantha*; this is used as a key character by both Leach and Bruyns. The coronas are practically identical.

Tromotriche Haw. Section **Caruncularia** (Haw.) Bruyns

T. umdausensis (Nel) Bruyns [colour p. 178] (*Caralluma umdausensis*, *Tridentea umdausensis*): From Eksteenfontein in the Richtersveld to Pofadder in Bushmanland, at Warmbad in Namibia, southwards to the eastern Khamiesberg. It lies east of *T. aperta*. The bluntly 4-angled stems (up to 90 mm) are similar to those of *T. aperta*. The striking, distinctive flower (diameter 22 mm) is solitary on a long pedicel (20–30 mm) near the stem apex. The united part of the corolla forms a shallow bowl, reddish-purple inside, striated by about 20 radiating white lines which travel outwards to the greenish yellow corolla lobes. The corolla disc is somewhat thickened but not an annulus, the base of the tube is densely papillate. The species is distinguished from near allies by the blackish-purple cup-like corona with a crenulate rim, the short inner lobes of the inner corona incumbent on the anthers but not exceeding them; in *T. aperta* these lobes rise up in the usual manner.

T. aperta (Masson) Bruyns [colour p. 178] (*Caralluma aperta*, *Tridentea aperta*): From southern Namibia to northern Namaqualand, lying west of *T. umdausensis* from Steinkopf to Garies. A beautiful species with obtusely 4-angled glaucous stems (50 mm) which resemble those of *T. pedunculata*. The entirely glabrous bicoloured flower (35 mm in diameter) is borne on a long pedicel up to 140 mm, the flower suberect, variable in size, about 40 mm across, with a small central cup which is densely papillate inside and dark purple; the corolla lobes widely spreading and with reflexed margins, the apical half of the lobe darker than the lower half. The outer corona is cupular, crenulate-papillose, the inner corona lobes connivent-erect and carunculate at their extremities. In his description, Leach emphasises the variation in the flower, especially in the corona.

T. pedunculata (Masson) Bruyns (*Stapelia pedunculata*, *Tridentea pedunculata*): Centred in the Khamiesberg area, the species has a great range from the Ceres Karoo northwards to the southern

margin of the Gariiep area. This species which has striking bicoloured flowers on very long pedicels was described in 1796. The round, scarcely toothed stems are indistinguishable from *T. aperta*. The flowers which are about 70 mm across are striking: the corolla is rotate, deeply and narrowly lobed, starlike, both surfaces glabrous, the disc and basal part of the lobes white, the distal part greenish to purple-brown with strongly recurved margins; the sinuses between the petals are beautifully ciliate with purple vibratile hairs, the margins otherwise glabrous. The two horns of the inner corona each terminate in a spiky knob – this feature accounts for the name of the section *Caruncularia*. The species name refers to the very long pedicels (the peduncle is in fact very short, and is the axis of the inflorescence, the pedicel is the axis of the flower; the narrow difference was not applied by Masson). The outer corona lobes are oblong, suberect, the inner lobes 2-horned, both clavate and carunculate, shiny black or brown, but variable. The flowers have a nauseous odour. ***T. longipes*** (Luckhoff) Bruyns [colour p. 178] (*Stapelia longipes*, *Tridentea longipes*): From Witputz in southern Namibia to the Richtersveld in northern Namaqualand. This agrees with *Tromotriche pedunculata* in most respects but Leach (1980) insists that the two species are distinct on grounds of corolla surface: in *T. longipes* the corolla face is densely reticulate-rugose, in *T. pedunculata* the upper corolla surface is lightly rugose. Other characters such as length of pedicel, shape of inner corona lobes vary constantly. Bruyns (1995) makes no comment. Also in the complex is ***T. ruschiana*** (Dinter) Bruyns (*Stapelia ruschiana*, *Tridentea ruschiana*) from the Klinghardt Mountains in Namibia, but this is a distinct species with a bicoloured campanulate corolla. According to White & Sloane (1937) the bell-shaped centre is dark red and thickly papillate, followed by a white area, red-dotted, the distal part of the lobes is dark reddish-brown. The lobe margins near the disc are fringed with vibratile club-shaped hairs. The outer corona is dentate apically and suberect, the inner lobes 2-horned with clavate gnarled heads as in *T. pedunculata*. The three-species complex extending from the south-western Cape to Namibia are well-connected to each other. Vegetatively the obtuse-angled stems are indistinguishable.

T. herrei (Nel) Bruyns [colour p. 178] (*Stapelia herrei*, *Tridentea herrei*): From Helskloof and Vioolsdrift south to Steinkopf in the Richtersveld. A distinctive species with glabrous, obtusely 4-

angled stems 70–120 mm long, and solitary, up-turned bell-like flowers which develop from the upper part of the stem on erect pedicels about 30 mm long. The corolla is widely campanulate. The species is immediately recognised by the extremely rugose nature of the inner surface of the corolla: white ridges on a light purple ground are emphasised by the slightly rolled back margins of the corolla lobes. The outer corona lobes are suberect, canaliculate, spout-like with truncated tips. The inner corona is 2-horned, swollen, club-shaped, the apices smooth. It is the only member of Section *Caruncularia* with smooth inner corona lobes, excepting *T. umdausensis*, which is very different, the inner lobes not ascending. (In Section *Tromotriche* both *T. revoluta* and *T. longi* have carunculate corona lobes so this character is not used as a separating factor).

***Orbea* Haw.**

When Linnaeus set up the genus *Stapelia* in 1737, his description was based on *S. hirsuta* and *S. variegata*. In 1812 Haworth transferred *S. variegata*, which has a characteristic disc-like annulus, into his new genus *Orbea*, thus recognising *S. hirsuta* as the type species for *Stapelia*. For the next 125 years *Orbea* was accepted, rejected or used at sectional level. In 1937 White & Sloane used *Orbea* and five other Haworth names at sectional level. It could be said that for the next 38 years everybody knew what a stapelia was, even if it was not a stapelia. And, in fact, were generally happy to do so. The position was somewhat confused in 1933 by the introduction of a new genus, *Stultitia*, for a group of plants which showed affinities with *S. variegata*. This resulted in certain very closely related species being placed in different genera. In 1975 Leach reinstated Haworth's genus, *Orbea*, with *O. variegata* as its type species. He placed *Diplocyathia* and most of *Stultitia* in synonymy with *Orbea*. (*Kirkia* 10(1), 1975). Leach followed up with a review of *Orbea* and description of three new genera, *Orbeopsis*, *Pachycymbium* and *Orbeanthus* (*Excelsa Tax. Series* 1, 1978). The four genera are under revision by P. Bruyns of the Bolus Herbarium, University of Cape Town.

Orbea has the following characters: dwarf, succulent plants with glabrous, fairly short, more or less erect stems, obtusely 4-angled, with large tubercle teeth usually possessing stipular denticles just below the apex, rudimentary leaves absent, the

flowers more than 30 mm in diameter, the corolla finely wrinkled or warty, with a markedly raised annulus, glabrous or slightly rough but never hairy as in *Stapelia*, mostly with marginal vibratile cilia.

Only recent synonyms are given in brackets in the following account.

O. ciliata (Thunberg) Leach [colour p. 178] (*Diplocyathia ciliata*): In karoid veld from Calvinia to the Ceres Karoo. Short, glabrous, 4-angled, prominently toothed stems which strongly resemble those of *O. namaquensis*. The striking, nearly white flowers are borne singly near the base of the stems; the corolla is smooth outside and rugose within, and the spreading lobes thickly fringed with moving, white, clavate hairs; the funnel-shaped annulus stands 8 mm high, with recurved rim and dotted with purple. This beautiful, almost odourless species was discovered by Thunberg and was the first species illustrated in the *Stapelieae Novae* of Francis Masson.

O. namaquensis (N.E.Br.) Leach [colour p. 178] (*Stapelia namaquensis*): From Richtersveld to Bushmanland and southwards to Springbok and Spek-takel. This species looks like a gross form of *O. variegata*: its chunky, decumbent, stoutly toothed stems are thicker and its flowers usually larger than those of its relatives. The flowers (70-100 mm in diameter) often lie flat on the soil, the pale yellow corolla is very rugose and marked with purple-brown lines or spots; the swollen annulus being so recurved that it is almost circular in cross-section. As in *O. variegata*, the flowers are extremely variable.

O. variegata (L.) Haw. [colour p. 179] (*Stapelia variegata*): South-western Cape from Lambert's Bay to Mossel Bay, especially common on the mountains of the Cape Peninsula, and extending east as far as Humansdorp in the Eastern Cape. It was included in a collection by a homeward-bound missionary, Justus Heurnius, in about 1639, and thus became the first stapeliad to reach Europe. It is of little comfort to those who today despair of the frequent name changes for the succulent species to know that in those pre-Linnaean days *O. variegata* was called 'Fritillaria crassa' – 'a thick (succulent) type of lily'. The glabrous stems are 30-140 mm long, usually much narrower than in *O. ciliata* or *O. namaquensis*, with conical, acute, spreading teeth. The typical flower is 50-70 mm in diameter with a conspicuous flattish annulus, the corolla is



Orbea variegata

rugose, pale yellow with scattered dark spots. The inner corona lobes are 2-horned, which feature distinguishes it from all close relatives except *O. pulchella*. N.E. Brown distinguished no less than 19 varieties; a futile task when one considers that all aspects of the flower are variable, and the species produces freak flowers and crested stems with ease.

O. lepida (Jacq.) Haw. (*Stapelia lepida*): Apparently raised from seed by Baron de Jacquin at Schönbrunn in about 1800. The stems resemble *O. variegata* but the flowers are quite different: smaller, the annulus white, red-spotted, the lobes yellow with dark purplish transverse markings. The plant has no known origin, and nothing like it has been collected in South Africa in present knowledge. Leach included it in his review because of the possibility of tracing it in herbarium material.

O. pulchella (Masson) Leach (*Stapelia pulchella*): From Baviaanskloof to the coastal area around Port Elizabeth and near Grahamstown in the Eastern Cape. The glabrous stems (50-100 mm) are similar to those of *O. variegata*, but smaller. The corolla (diameter 30-55 mm) is sulphur-yellow with small dark dots; the disc forms a shallow saucer with a solid annulus. It is difficult to find a substantial described distinguishing character between this species and *S. variegata*, apart from the recurved acute-edged rim of the annulus of the latter, which is missing in *O. pulchella*.

O. verrucosa (Masson) Leach (*Stapelia verrucosa*): Eastern Cape. The specific name means 'warty' and refers to the nature of the handsome pale yellow flowers which are covered with blood-red spots and small raised tubercles or ridges. The

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absent) bear little relation to the strongly-toothed upright stems of *Orbea*. The *Orbeanthus* flower is relatively large with a broad smooth annulus and hairy corona. Of the two species concerned (both of which were formerly included in *Stultitia*), *Orbeanthus conjunctus* has a cup-like bicampanulate corolla while in *O. hardyi* the corolla lobes are largely free, with a very short corolla tube.

O. conjunctus (White & Sloane) Leach (*Stultitia conjuncta*): In the vicinity of Louis Trichardt in the Northern Province, on ledges of steep rock faces in Wyllies Poort and the southern Soutpansberg. A procumbent species with greyish-green, mottled stems, tubercle teeth 1-5 mm long. The cupular flowers are constricted towards the base by a crimson annulus, the upper portion of the tube and the corolla lobes are flesh coloured.

O. hardyi (R.A.Dyer) Leach [colour p. 179] (*Stultitia hardyi*): Also in Wyllies Poort but with a further distribution from south-east of Pietersburg to Ohrigstad in northern Mpumalanga. The reddish purple, almost round stems (up to 300 mm long) sprawl and branch freely on rocky ledges. The flowers, which develop slowly, are liver-coloured mottled with yellow, and have a cushion-like smooth annulus; the corolla lobes which are free for almost their whole length (25 mm) are minutely papillose. It is further distinguished from *O. conjunctus* by its elongated, erect, hairy inner corona lobes.

Orbeopsis Leach

The new genus *Orbeopsis* was set up by Leach in 1978 for a small group of closely-related species which until then had been included in *Caralluma*. Although vegetatively similar to the genus *Orbea*, the group concerned proved to be sufficiently distinct to warrant separate generic status rather than transfer to *Orbea*. Important distinguishing factors are the umbel-like fascicles of flowers with several to many opening together and the absence of an annulus. A further character is the very strong foetid odour given off by the blooms. The species occur in southern tropical and subtropical Africa. Five of the ten species are closely related and have flowers with conspicuous corolla tubes: *O. gerstneri*, *O. valida*, *O. gossweileri*, *O. huillensis* and *O. tsumebensis*, according to Bruyns (*Aloe* 26 (1 and 2), 1989). Three species are widely distributed and

all have narrow petals (at least in the typical plants), these are *O. lutea*, *O. valida* and *O. caudata*. Other species have a narrower, sometimes very localised distribution.

O. lutea (N.E.Br.) Leach [colour p. 179]: Subsp. *lutea* (*Caralluma lutea*, *C. lateritia*, *C. vansonii*) occurs in Zimbabwe, Mozambique, Botswana and, where present, it lies north of 30° south in South Africa. This is the only stapeliad which has successfully driven the author out of the shade house with its odour of long dead fish. The crowded stems are stoutly dentate, green mottled with purple, producing great clusters of beautiful yellow flowers in which the lobes are 3 to 5 times longer than broad, and ciliate with vibratile, purple hairs. In Zimbabwe and Botswana, plants with maroon flowers occur and have been known by the synonym *O. lateritia*. Subsp. *vaga* (*Caralluma vaga*, *C. nebrownii*, *C. hahnii*, *C. pseudonebrownii*) occurs in Angola (Huila District); Namibia and the Northern Cape at Keimoes and Kakamas. It is distinguished by its much broader petals which are 1.5 to 2.5 times as long as broad. Their colour varies greatly from mostly reddish-brown to variegated red and yellow and pale lemon yellow. The corona is cup-shaped, the outer lobes are yellow, quadrate and spreading, the inner lobes two-horned, the inner horn connivent-erect.

O. albocastanea (Marloth) Leach (*Stapelia albocastanea*, *Caralluma albocastanea*): Recorded from Maltahöhe and the Great Karas Mountains in Namibia. The specific name which means 'white and chestnut' refers to the colours of the spotted corolla. The low, branching stems (60-80 mm) curve upwards and produce small, deeply lobed, rugose, ciliate flowers (25 mm in diameter) which are creamy, spotted with purple-brown, on long pedicels (40-60 mm). The outer corona is dark brown, the inner corona has a long dorsal horn from the base, as well as the inner erect horn.

O. knobellii (Phillips) Leach (*Caralluma knobellii*, *C. kalaharica*): Botswana; near Kuruman River in the Northern Cape. This species is rather rare on the Kalahari soils, and, like several other stapeliads growing in sand, it develops underground rhizomes. The stems (100 mm) are sharply angled with acute teeth. The striking clusters of white flowers are blotched with blackish-purple, the corolla about 35 mm in diameter, the corolla lobes ciliate with vibratile clavate purple hairs, the lobes

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Dyer in 1938 from material collected in the Gwanda district of Zimbabwe. The stems (150 mm) produce handsome, dark purplish, rugose flowers (up to 150 mm across) with tail-like lobes which are ciliate with long clavate hairs. Responsible reports of its spontaneous appearance in three gardens in Zimbabwe indicated that the plant was a hybrid, the parents almost certainly being *Stapelia gigantea* and *Orbeopsis caudata*, both of which were also present in the gardens.

Pachycymbium Leach

Pachycymbium was set up by Leach (*Excelsa Taxon. Series 1*, 1978) for two species, *P. keithii* and *P. carnosum*, both formerly held in *Caralluma*. In 1990 Gilbert (*Bradleya* 8) reviewed *Caralluma* and this involved a movement of several species into *Pachycymbium* from *Caralluma* and *Stultitia*. Currently 8 species are listed under *Pachycymbium* and the genus is under revision by Bruyns.

According to Leach his new genus differed from *Orbea* in having small, campanulate flowers borne in fascicles at the sides of the stems, often near the apex, an annulus around the mouth of the corolla tube and the corona deeply urceolate with the inner lobes incumbent on the anthers and not erect above them.

P. schweinfurthii (Berger) Gilbert (*Caralluma schweinfurthii*, *C. piaranthoides*): Zimbabwe, Northern Province in South Africa, Namibia, Zambia and northwards to Tanzania. The Zimbabwe plants were known as *Caralluma piaranthoides* (1935) until it was realised that they were identical with the more northerly *C. schweinfurthii* which was described in 1910. A creeping species, it is often hidden under dead leaves. The stems have long, curved, pointed teeth which possess small denticles. The yellow flowers are very small (12-15 mm across), spotted with red, and have a shallow tube. Gilbert places this species in the 'Sprengeri' group, in which the corolla is shallow-campanulate to rotate, glabrous or finely hairy, the outer corona annular to saccate. He finds *Pachycymbium schweinfurthii* different from the rest of this group because of its bicoloured papillate corolla and the serrated margin of the outer corona.

P. ubomboense (Verdoorn) Gilbert [colour p. 179] (*Caralluma ubomboensis*): Lebombo Mountains in Swaziland, KwaZulu-Natal, south-east corner of

Zimbabwe. A dwarf species under 60 mm high; stems 4-angled with spreading teeth tipped with small erect leaf rudiments. Flowers erect, pedicel 5 mm long, corolla 9 mm across, rotate, dark purple, rugose, papillate. Outer corona deeply bifid with horns divergent and spreading. Gilbert puts this species and *P. miscellum* in his 'Ubomboense' group, in which the corolla is rotate and rugose, the outer corona lobes bifid.

P. miscellum (N.E.Br.) Gilbert (*Stapelia miscella*, *Stultitia miscella*, *Caralluma bredae*): In the Great Karoo from Beaufort West to Cradock in the Eastern Cape and southwards to Klipplaat. Bruyns gives an interesting, illuminated account of this species in *Excelsa* 10, 1982. Stems stoloniferous, producing erect stems up to 70 mm high under bushes. Flowers rotate, reddish to dark purplish-brown, with a slightly raised annulus, the corolla lobes spreading, broad-based and acuminate. Outer corona lobes rectangular, truncated, the inner lobes not incumbent on, but erect and curving over the anthers. The basal inflorescences and long pedicels relate the species to *Orbea*, which is close to *Pachycymbium* (Gilbert, 1990); the species is located far south of the main distribution of the genus.

P. keithii (R.A.Dyer) Leach [colour p. 179] (*Caralluma keithii*, *C. fosteri*, *C. schweickerdtii*): Widespread in Zimbabwe, the Northern Province and Mpumalanga (Transvaal), Swaziland, KwaZulu-Natal and Mozambique. The species is extremely variable and often hidden among dead leaves under trees. The bluish-green, mottled stems are 70-90 mm high, much thicker than the slender underground rhizomes, the stems deeply 4-angled with prominent, alternate, triangular teeth which are laterally compressed. Bell-shaped flowers in groups of 1-3, corolla about 12 mm in diameter, rich maroon, dotted or striped in yellow, with a few clavate hairs near the base of the lobes; the annulus surrounding the mouth of the tube. Outer corona cup-like, deeply bifid, higher than the staminal column. **P. lancasteri** Lavranos refers to a collection made north of the Letaba River in Northern Province, South Africa. According to Bruyns this is a yellow-flowered form of *P. keithii* (pers. comm.). Gilbert places this alliance and *P. carnosum* in the 'Keithii' group, which has prominent denticles on the tubercles, the inner corolla rugose, prominent annulus, and a bifid outer corona.

P. carnosum (Stent) Leach (*Caralluma carnosum*):

Waterberg Mountains in the Northern Province, Magaliesberg in Gauteng (both Transvaal provinces). The specific name refers to the small, rigidly fleshy, bell-like flowers (8 mm in diameter) in groups of 1-3 between the stem angles. The erect, greyish-green, 4-angled stems (60 mm tall) are flecked with purple, the teeth spreading-ascending, with denticles below the apex, angles flattened after the manner of *P. keithii*. The corolla is cream inside with purple spots, densely verrucose, with an inconspicuous annulus at the mouth of the tube. The cup-like outer corona is deeply bifid, exceeds the staminal column, and fills the corolla tube. The inner corona lobes are incumbent on the anthers, only 1 mm long.

P. rogersii (L.Bol.) Gilbert [colour p. 179] (*Stapelia rogersii*, *Caralluma rogersii*): Botswana, Northern Province in South Africa, Sabi and Limpopo River valleys in Zimbabwe. This unique and sought-after tropical species is not easy to cultivate. The stems (100 mm) have rounded angles and long narrow teeth (18 mm), with denticles, similar in habit to *Orbea tapscottii*. The delicate pale yellow flowers have short hairs on the disc, the base of the corolla lobes are ciliate with transparent, multicellular hairs, each ending in a tiny glistening sphere. The inner corona is most remarkable, each lobe dividing into a series of 8 mm-long tendrils. Gilbert classes both this species and *P. lugardii* as 'isolated species' because of their unusual features. Gilbert comments that the vibratile marginal hairs and the long processes of the inner corona are unmatched in *Pachycymbium*.

P. lugardii (N.E.Br.) Gilbert [colour p. 179] (*Caralluma lugardii*, *C. longicuspis*): Botswana, Prieska in the Northern Cape of South Africa, from Windhoek southwards in Namibia, Zimbabwe, Zambia. Gilbert places this species in *Pachycymbium* 'with some trepidation' but is certain of its position in the *Orbea-Pachycymbium-Tridentea* group of genera. A most attractive small species (50-70 mm tall) freely branching from the base, obtusely angled with small acute teeth. The long, narrow buds near the apex of the stems open into spidery flowers with campanulate tube and gracefully curved, linear corolla lobes 25 mm long. The colour of the corolla varies: all wine-red or chocolate, wine-red centre with greenish-yellow lobes, green centre with yellow lobe tips. Its minutely puberulous corolla and corolla tube with revolute lobes distinguish it from other southern pachycym-

biums. The outer corona has five pairs of small teeth, the inner corona is connivent-erect, and its dorsal projection is also toothed, producing the effect of a 15-20 toothed outer corona edge.

Stapelia L.

The genus *Stapelia* was set up in 1737 by Linnaeus who derived the name from that of Johannes van Stapel, a 17th century physician and botanist. By the end of the century, more than 50 species had been described. In 1809, Robert Brown proposed the separation of *Caralluma*, *Huernia* and *Piarranthus* from *Stapelia*. In 1812, Haworth greatly reduced the limits of *Stapelia* by naming nine new genera of which *Duvalia* and *Pectinaria* are still upheld, and *Orbea*, *Tromotriche* and *Tridentea* have recently been reinstated. In the revision of *Stapelia* by L.C. Leach (*Excelsa Tax. Ser. 3*, 1985) the generic concept is based on vegetative characters supported to some extent by floral characters. In his publication he lists a shift of species out of *Stapelia* into 16 other genera (three of which have since been 'sunk' and *Caralluma* can barely hold its head up in southern Africa). This is not surprising, as *Stapelia* was the 'mother' genus of the whole group. The greatest shift was to the reinstated *Tridentea* and *Orbea* genera, with a fair number placed in *Huernia* and *Duvalia*. Of course since 1985 there has been a reappraisal of *Tridentea* (Bruyns, 1995) which is now quite a small genus. In 1985 Leach recognised 43 species of *Stapelia* which number includes several new species; it is generally felt that there are too many names in *Stapelia*, and it is very probable that in the next revision a fair number will fall away.

Although present in a wide variety of habitats, stapelias are most often found in arid areas south of the equator and concentrated in South Africa. They are thinly scattered and do not often occur as populations as in other succulent genera. The plants are small, branching from the base, not rhizomatous, the stems pubescent or glabrous, 4-angled, with tubercles on the angles which subtend small, scale-like, erect leaves, falling early or drying off, with small stipular glands at the base. The inflorescence is always pubescent, the inner (adaxial) surface of the corolla is often hairy with fine, simple, unmoving hairs.

S. gigantea N.E.Br. [colour p. 179] (*Stapelia nobilis*, *S. marlothii*, *S. cylista*, *S. youngii*): A widespread

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to north of Butterworth in the Eastern Cape. The plants are erect to a height of 175 mm, the stems glabrous, about 15 mm thick, and 'tapering to both ends'. The inflorescence is basal, the flowers usually flat on the ground with scarcely pubescent pedicel 20-40 mm long. The corolla is rotate, about 75 mm across, glabrous on the lower surface, upper surface shiny dark purplish-brown, rugulose, pubescent around the corona and in the radii between the lobes (as in *S. asterias*), with long marginal hairs. Corona blackish-purple, the inner corona lobe is about 8 mm long, with a narrow inner horn widely spreading from its base.

It is very unlikely that the *asterias-peglerae-tsoemoensis* complex will stand up to a full field revision, which Leach was unable to do, and it is hoped that this new revision will appear in 2000.

S. asterias Masson (*Stapelia asterias* var. *lucida*): From Barrydale to Uniondale in the Little Karoo. Compact erect plants to 150 mm with densely pubescent grey-green stems, about 15 mm thick. Leaves pubescent, up to 5 mm long, marcescent. Inflorescence is a basal, pubescent, pedunculate cyme, pedicels up to 65 mm long. The often striking shiny flower (the name 'asterias' means 'starfish') is rotate, 75-110 mm across, the upper surface always very shiny, dark purple, sometimes with yellowish transverse lines, slightly hairy on the radii between the lobes which are convex, rugulose, with long marginal hairs. The corona is dark purple and variable.

S. praetermissa Leach [colour p. 180]: This new small-flowered species from Kariega River valley in the Eastern Cape was described in 1984. The erect clumps have slender, glabrous stems to 120 mm, almost flat-sided, angles weakly tuberculate. The inflorescence develops on the sides of the stems (different from preceding species), buds ovoid-attenuate, the flowers on pedicels up to 6 mm, facing upwards. The corolla is 30-50 mm across, glabrous below, the upper surface with long fine hairs on the radii between lobes and on the margins; the corolla has a shallow, pentagonal funnel-shaped tube, the lobes up to 20 mm long, attenuate, convex, rugulose and slightly shiny. In var. *praetermissa* the corolla is reddish-purple to dark maroon with a black corona. Var. *luteola*, described from a single plant collected at Vaalvlei (14 km east of Salem), has a pale yellow corolla and corona, the lobes pinkish-brown towards the apex.

S. baylissii Leach: Known only from the northern

aspect of the Suurberg in the vicinity of Oudekraal, Eastern Cape. A compact, erect plant up to 150 mm. Stems glabrous, about 15 mm thick, the four angles prominent. Inflorescence near the base of the stems, flowers produced in succession, the stout peduncle persistent, the pedicel 6 mm long and pubescent. The flowers (as in *S. praetermissa*) are 30-60 mm across, the lobes narrow and tapering, reflexed, dark purple, shiny, strongly rugose with sparse cilia on the revolute margins.

S. vetula Masson [colour p. 180] (*Stapelia nudiflora*): Located on the mountains from Jan Du Toits Kloof in the south-western Cape to Uniondale in the Little Karoo. The stem clumps are up to 200 mm high, 10-15 mm thick, puberulous, green to purple. Both rudimentary leaves and stipular glands are caducous. Inflorescence near the base or on the sides of the stems, pedicel puberulous, 10-20 mm long. The flower is 60 mm across, both surfaces and the margins devoid of hairs, the disc smooth and naked, blackish-purple without markings. The outer corona lobes are reddish, oblong and spreading; the inner lobes are blackish, the inner horn prominent, 6 mm long.

S. macowanii N.E.Br.: This name is founded on material of uncertain locality; the material may be an aberrant form because in some instances the inner corona lobe consists of a wing only, the inner horn being absent. The well collected, similar but later published *S. conformis* N.E.Br. from the karoo areas of the Eastern Cape to Hellspoort near Grahamstown is reduced by Leach to a variety under *S. macowanii*, for quantitative reasons. *S. conformis* has erect velvety stems (120-270 mm) which bear beautiful large flowers (70-150 mm across) at the base of the plant. The corolla is rugose, the lobes largely purple shading to yellow crossed with purple lines at their base and on the disc, sparsely ciliate on the margins. It is close to N.E. Brown's description of *S. macowanii* but its inner corona lobe divides into a dorsal wing and an inner horn in the regular manner, and its flowers are much larger.

S. pillansii N.E.Br.: In the Laingsburg-Matjiesfontein area in the southern Great Karoo, and from around Ladismith in the Little Karoo. The pubescent stems are 120-200 mm tall, with leaves 3 mm long. The extraordinary purple-brown flowers (overall diameter 125-200 mm) produce narrow petals with long tail-like ends; the glabrous, shining, slightly rugose corolla is glabrous except for slen-

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in a re-assessment of *Tromotriche*, Bruyns transferred *T. engleriana* back to *Stapelia*.

S. cedrimontana Frandsen: Citrusdal area in the south-western Cape (Cedarberg and Piquetberg). This plant has erect, 4-angled stems up to 250 mm long with prominent angular ridges. Inflorescence mostly on the lower half of the stems, pedicel about 25 mm long. The flowers (48-60 mm in diameter) dark purple with yellow transverse ridges on the disc and base of the lobes, the whole inner surface being rugose and the revolute margins of the lobes lightly ciliate; the corolla with a shallow pentagonal tube. The outer corona lobes are oblong, spreading, apiculate or dentate, the inner corona lobes incumbent on the anthers, with a small dorsal wing.

S. villetiae Luckoff: Western Great Karoo between Loeriesfontein and Calvinia in what is now Northern Cape. Pubescent, bluntly 4-angled dark green stems up to 160 mm tall, about 15 mm thick. Large beautiful flowers on pedicels up to 65 mm long are transversely striped in purplish-black against a pale lemon ground; the corolla rotate but with a shallow tube, up to 65 mm across, the broad corolla lobes narrowing sharply to a long point, recurving, the purple-black condensing on the outer part of the lobe. Corona also blackish, the inner lobes about 5 mm long, incumbent on the anthers with an erect inner horn. The species is self fertile.

S. surrecta N.E.Br. [colour p. 180] (*Stapelia surrecta* var. *primosii*): Western Great Karoo, Sutherland to Calvinia, mainly on steep slopes of the escarpment. Plants form small, spreading clumps, stems obtusely angled, to 80 mm or more in length, up to 12 mm thick, rudimentary leaves marcescent, stipular glands inconspicuous. Distinctive are the terminally placed inflorescences, bearing quite small flowers on erect pedicels up to 35 mm long. Corolla has a short pentagonal tube, the colour varies from yellow to brown or maroon, 17-40 mm in diameter, the lobes spreading with usually extended narrow tips, the upper surface rugulose and glabrous. The corona is stipitate, the inner corona is yellowish, with a slender inner horn and a dorsal wing.

S. acuminata Masson [colour p. 180] (*Stapelia indocta*): Namaqualand and the western karoo (Nieuwoudtville to Loeriesfontein). Stems obtusely 4-angled to a height of 100 mm, furrowed between angles, small leaves caducous. Inflorescence devel-

ops on the sides of the stems, flowers produced in a cluster, buds ovoid-acuminate, corolla glabrous and transversely rugose over its whole surface, dark purple with yellow lines, but the colours very variable. The lobes are broad-based with narrow tips ('acuminata' refers to this), the margins ciliate with white non-vibratile cilia. The outer corona lobes are bilobed and the inner lobes purple-spotted. The species is distinguished from *S. villetiae* and *S. cedrimontana* (geographically close) by its smaller flowers (17-40 mm across) and short pedicels. Its flowers are about the same size as those of *S. arenosa*, but the latter sometimes has an annulus-like disc thickening, the surface more rugulose and with short corona lobes.

S. flavopurpurea Marloth: Widespread in the Northern Cape from Griquatown to Vanwyksvlei and Britstown; Namibia from near Windhoek southwards to Rosh Pinah and Grūnau. The localities of herbarium specimens are mostly close to towns which indicates that the species is under-collected. This is an extraordinary stapelia with small flowers borne on the upper part of the stems, with very narrow radiating corolla lobes and the disc a contrasting colour. The square stems are about 100 mm in height, 10 mm thick, with fairly blunt, toothed angles. The peduncle is short, pedicel about 30 mm, erect; the corolla, 30-40 mm in diameter, has a slight tube, the disc white to pink with erect clavate hairs, the narrow corolla lobes strongly revolute with margins devoid of cilia, varying in colour from dull yellow or green to red, transversely rugose, the whole giving off a sweet faint scent, becoming evil-scented in the darker flowers. The colour of the corona is often nearly white which is unusual, the outer corona lobe with revolute sides, forming a deep nectar cavity. Var. *fleckii* is synonymous here.

S. olivacea N.E.Br.: Reliable records indicate central Great Karoo, from Olifantshoek in the north to about 31° South, not further south than Loxton, Victoria West and Middelburg. Stems (70-120 mm) obtusely angled with longitudinal furrows, puberulous, tubercles unapparent with small leaves caducous. Inflorescence basal on young stems, the flowers vary from pale red to deep purple-black, pedicel about 5 mm long, the corolla 20-40 mm across, somewhat campanulate, deeply rugose and with foetid smell; the corolla lobes broadly triangular, recurving, margins ciliate; the corona is dark purple and slightly raised.

S. pearsonii N.E.Br.: Widespread though uncommon in the Great Karas mountains, north-east of Grūnau in southern Namibia. The stems of this species look exactly like those of *S. olivacea*, but the flowers are slightly different. Inflorescence shortly pedunculate and near the base, pedicel densely pubescent, upright, up to 40 mm long. The face of the flower is glabrous, brownish-purple, 35-50 mm across. The corolla lobes are spreading (not recurving), somewhat convex, rugulose and longitudinally furrowed, the margins nude. The outer corona is dark purple, shiny, outspread on the disc, the lobes 4 mm long.

S. divaricata Masson: A very 'old' Cape species rarely located between Swellendam and Heidelberg in the coastal region south of the Langeberg, and possibly in the Little Karoo east of Barrydale. The slender, crowded, erect or straggling stems (100 mm) have minute puberulous erect leaves. Inflorescence basal or lateral on stems, the deeply-lobed flowers (up to 40 mm in diameter) appear to be glabrous on both surfaces but are micro-pubescent, the smooth shiny corolla is dull purple to pale flesh-colour inside, green at the tips of the lobes which have revolute margins, the lobes partly ciliate with simple white hairs. The outer corona lobes are oblong and spreading, the inner corona lobes very short and incumbent on the anthers.

S. kwebensis N.E.Br.: Widely in northern Namibia, Botswana, Zimbabwe lowveld and low-lying areas in the Transvaal provinces. A tropical species which was first found near Kwebé south of Lake Ngami in Botswana. It is very difficult to cultivate in heavy summer rainfall areas as the stems are most susceptible to fungal attack in warm, wet weather. The erect stems (100-200 mm) are fresh green, round-angled, minutely pubescent, shortly toothed with erect, prominent rudimentary leaves. The small, reddish-brown, evil-smelling flowers (diameter 30 mm) are rugose and hairless on the inner surface, and borne close to the stem on short pedicels. According to Plowes, this lowveld species prefers silty and alluvial soils, keeping to the river valleys in the south of Zimbabwe, where he found it hybridising with *Orbeopsis caudata* and *Orbea maculata*. **S. similis** N.E.Br. (*Stapelia noachabensis*): This name is presently applied to plants in the Richtersveld, towards Upington in the Northern Cape, and from Rehoboth to Grūnau in Namibia. A cup-like depression houses the corona, and the flowers which are carried on long pedicels (30-55

mm) are usually spread on the ground around the plant. It occurs with *S. kwebensis* var. *longipedicellata* (elevated to species level by Leach, 1985) in several areas without any sign of intergradation (Bruyns pers. comm.). In *S. kwebensis* var. *longipedicellata* (White & Sloane, 1937) which occurs from north to south in Namibia the flowers are held above the stems on long pedicels, in erect fashion. Leach states that 'the plants are vegetatively indistinguishable from *S. kwebensis*' and in addition to the height of the flower he uses a gradation of odour as a distinguishing character of the three taxa. A fourth member of the *kwebensis* complex, **S. parvula** Kers is known from 10 km north of Moçamedes in the coastal desert of Angola. *S. parvula* is described as the smallest species of the genus, the stems obtusely 4-angled, parallel-sided, up to 30 mm tall, 5 mm thick. Rudimentary leaves and stipular glands are present. The inflorescence is set at random on the stems, the pedicels up to 25 mm long and prostrate, the flower up to 8 mm across, the upper surface brown, minutely pubescent and obscurely rugose. These tiny plants wedged between rocks were discovered by Kers in 1968 and collected again since then by Leach and Cannell. They are probably a northern extension of *S. similis*.

S. arenosa Luckhoff: A western karoo distribution from Khamiesberg in Namaqualand and Calvinia southwards to Ceres Karoo and Karooport. *S. acuminata* has much the same distribution but although its flowers are fairly small (under 40 mm in diameter as in *S. arenosa*) its disc and corona are different. *S. arenosa* has a few erect pubescent stems to 75 mm high, relatively thick at 10 mm, deeply grooved with prominent tubercle teeth on the rounded angles. Inflorescence develops from the side of the stem, producing a cluster of buds and flowers. Corolla rotate, up to 40 mm across, the disc somewhat thickened and having a whitish ground crossed by blackish-purple transverse markings which condense on the ovate-acuminate lobes to one colour, the entire face of the flower densely ridged, the margins shortly ciliate. The corona is raised, the outer lobes oblong or subacute and spreading; the inner lobes narrow, up to 3 mm long, erect with a triangular dorsal wing.

S. rubiginosa Nel: Very local in the Richtersveld. Tall, clump-forming to 120 mm, green stems shade to dark purple at the apex, minutely pubescent with small, erect teeth on the four stem angles. The

flowers are in fascicles of 3 to 5, developing from above the middle of the stem on short pedicels; the corolla (20 mm in diameter) is rugose, with a greenish-yellow disc which shows a definite annular thickening, the corona stipitate in the well; the lobes dark purple, rugulose, reflexed, ciliate with very short, purple hairs. The outer corona lobes are deltoid and shortly ciliate, the inner lobes dark brown, suborbicular, obtuse and pubescent.

S. rufa Masson: The centre of distribution lies in the Little Karoo, as well as very scattered localities along the escarpment from near Loeriesfontein to Fraserburg in the Great Karoo. As the name implies, this is the 'rusty-red stapelia'. The plants form erect tall clumps to 100-220 mm, with shallow grooves between the obtuse, toothed angles, minutely puberulous. The inflorescence develops at random on the stem, producing clusters of campanulate dull, dark red to yellow flowers. Pedicels pubescent, to 6 mm long, the corolla about 36 mm across, the lobes narrowing, almost tailed, margins revolute and shortly ciliate, the whole upper surface finely rugose. Corona raised, outer lobes subquadrate, orange; inner lobes erect, oblong, almost black.

S. scitula Leach [colour p. 180]: As far as is known this later described species (1984) is localised from just west to south-east of Robertson in the south-western Cape where it has been collected at Langvlei and Eilandia, and recently by Mike Kamstra on the immediate foothills of the Langeberg at Tierhoek, at about 370 m. The slender stems stand neatly erect ('scitulus', *latin* for 'neat') to a height of 80 mm in between protruding layers of shale, the stems up to 120 mm in shade, 7 mm thick, green. The inflorescence is basal, flowers opening successively on pedicels 9-15 mm long. The corolla is rotate, 19-26 mm across, reddish-brown, densely covered with short maroon hairs, hairs longer on the margins, lobes rugulose, reflexed in the older flower. Outer corona lobes oblong, pale brown, inner lobes erect, dark purple. A second new species, **Stapelia montana** Leach from the south-western Cape was published at the same time as *S. scitula* (*S. Afr. J. Bot.* 3(3), 1984). *S. montana* var. *montana* which is very similar to *S. scitula* was collected in the Great Winterhoek Mountains north of Tulbagh; Leach separates the second new species on the grounds of having outer corona lobes twice as long. Leach also describes *S. montana* var. *grossa* for larger plants from the Witels River near Ceres. The coronas of *S. scitula* and *S. montana* are

very similar, the differences between the species are quantitative and do not qualify for separation at species level. An older member of this uncertain complex is *S. immelmaniae* Pillans of the Piquetberg Mountains, with tall stems up to 200 mm, 15 mm thick, pubescent and angles with prominent teeth. Inflorescence is usually near the stem apex, the pedicel to 15 mm long, corolla rotate and 40-45 mm across, the flat, starlike flowers are rugose, covered with soft, pale purple hairs, the disc pale olive-green with yellow lines, the corolla lobes dull purple with transverse yellow lines, ciliate with simple hairs.

S. kougabergensis Leach: Located on the Kouga Mountains in the Langkloof, on either side of the new border between Western and Eastern Cape, and eastwards to the Great Winterhoek Mountains and the western edge of the Suurberg. The plants form small clumps up to 200 mm high on north-facing sandstone slopes on rock outcrops among fynbos. The stems are pubescent, about 12 mm thick. Inflorescence basal or midway on stems, forming clusters of flowers with pubescent pedicels 20 mm in length. Corolla is 16-30 mm across, the upper surface almost glabrous, transversely rugose, yellowish on dull purple or the reverse, the purple consolidating towards the lobe tips. The flowers have no odour and the shape and indumentum of the corolla is variable. The dark red corona surrounding the whitish style-head is conspicuous in the shallow tube, the outer lobes subquadrate, the inner lobes awl-shaped, about 2 mm long.

S. paniculata Willd. (*S. concinna* var. *paniculata* (Willd.) N.E.Br., *S. nouhuysii*): In the vicinity of Lamberts Bay on the south-western coastline to Grey's Pass near Piquetberg in the Western Cape. The names here have a confused history. *S. paniculata* sensu Leach is applied to plants which form large spreading clumps, the short stems densely pubescent, to a height of 60-80 mm, 6-7 mm thick. The inflorescence is floriferous, the buds depressed-globose, the pedicel semi-erect to 35 mm long. The corolla is up to 30 mm in diameter, with a shallow saucer-shaped centre, the upper surface densely villous with white hairs on the disc and proximal part of the lobes, absent on the distal part of the lobe, the marginal hairs longer, up to 3 mm. The corona is brown to black, the outer lobes oblong, prominent and spreading, the paler inner corona lobes suberect, about 3 mm long, with a dorsal wing.

S. erectiflora N.E.Br. [colour p. 180]: A scattered distribution, but chiefly from Clanwilliam to Wuppertal in the Cedarberg region of the Western Cape. The stems are obtusely 4-angled and up to 150 mm high. The marked character of this species described in 1889 is the erect nature of the long pubescent pedicel, up to 120 mm, bearing a small purplish-grey flower, about 10-15 mm across, densely covered with white, clavate adpressed hairs, its corolla lobes rolled under, giving the flower a round outline. Leach sets up a new taxon, *S. erectiflora* var. *prostratiflora*, for a form collected north-west of Clanwilliam which has long,

prostrate-pedicelled flowers, the corolla lobes less severely recurved. According to Bayer these plants are hybrids between *S. erectiflora* and *S. glanduliflora*. The oldest member of this group is **S. glanduliflora** Masson [colour p. 180] which also occurs in the Clanwilliam-Klaver area in the Western Cape. The pubescent stems form clumps erect to 200 mm. Long club-shaped white hairs cover the upper surface of the yellow corolla which is up to 35 mm across, pedicels are prostrate, up to 50 mm long. Clavate hairs found in both *S. erectiflora* and *S. glanduliflora* distinguish them from the rest of the 'paniculata' complex (Bruyns pers. comm.).

Aloaceae

Aloe

Since the publication of *Succulent Flora of Southern Africa* (Court 1981) the large and most easily recognised family of the monocotyledons, Liliaceae, has been restructured. There are now two closely related orders, Liliales and Asparagales. The order Asparagales as related to southern Africa, contains three existing families as well as six new families. A new family name Asphodelaceae (Dahlgren et al. 1985) includes the succulent genera dealt with here as well as some geophytic and non-succulent species. The name Aloaceae Batsch has a narrower application and is composed of the six African genera as well as *Lomatophyllum* of Madagascar.

Members of Aloaceae which follow are arranged according to their generic numeration which more or less follows the system of De Dalla Torre & Harms (1958). The large *Aloe* genus has a chapter of its own, the others, *Gasteria*, *Astroloba*, *Poellnitzia*, *Haworthia* and *Chortolirion*, form the contents of Chapter 8.

Aloe L.

Reynolds's two great works *The Aloes of South Africa* (1950) and *The Aloes of Tropical Africa and Madagascar* (1966) remain unchallenged in the reference field of this attractive, widespread essentially African genus. In 1960 the Linnean Society of London reported that Dr Reynolds had travelled more miles in Africa, in search of (*Aloe*) plants than any other plant collector living or dead.

Aloe has spread in its northern limits to the island of Socotra and into Arabia. It does not occur naturally on other continents. It is well represented and uniquely evolved on the large island of Malagasy which must, therefore, have been colonised by ancestral aloe types before its land mass separated from Africa. Grass aloes, members of the maculate

group and those species which have nearly horizontal racemes like *A. ortholopha* are absent from Malagasy, indicating their evolution after the separation of this island from the African continent.

The ancestors of the modern aloe seem to have had an adaptable character which has enabled them to colonise desert, mountain, grassland and beach. Out of the melting pot of genetic change the aloe came up with apparently superb adaptations to harsh environments – tough, spiked leaves with unpalatable juice, sunken leaf pores, brilliant flowers to attract pollinators, seeds designed for wind dispersal, and, in many cases, a high degree of vegetative propagation. And yet, when species distribution in southern Africa is studied it reveals that the aloes prefer the gentle eastern climates. The greatest numbers and variety of species occur in the eastern region of the Transvaal provinces, with KwaZulu-Natal running second. Zimbabwe, Mozambique and the Eastern Cape are all well populated by the genus, whereas in the central regions the numbers decline to nine species in the Free State and less in the Northern Cape. Species increase to 26 in Namibia and 22 in Angola. Only hardy pioneers braved the dry west and survived, possibly because the aloe has one inherent weakness – a relatively poor root system. Like other monocotyledons, the aloe develops a shallow fibrous root system which never achieves the deep permanence of the taproot of the earlier evolved dicotyledons.

To aid identification: If the locality of the plant is known, it helps to read all or most of the entries dealing with that region. If not, at least the characters and size of the plant will provide a guide, and reading will have to be much wider in order to identify the specimen. Good advice is contained in a letter from George Stark of Arizona, USA (1984) who said of *Succulent Flora* (First Edition): "I am presently reading it for the third time". In the following description the aloes are arranged geo-

graphically, taking size and relationships into account. When one measurement is given in brackets it refers to the maximum height or length of the species or part of the species described. Recent synonyms are placed in brackets after the valid name.

- 1 Tall Eastern Aloes
- 2 Small to Medium Eastern Aloes (excluding 'grass aloes')
 - 2.1 Eastern Cape and Lesotho
 - 2.2 KwaZulu-Natal and Swaziland
 - 2.3 Transvaal Provinces
 - 2.4 Zimbabwe and Mozambique
 - 2.5 Zambia
- 3 The Grass Aloes of Southern Africa
 - 3.1 Eastern Cape, KwaZulu-Natal and Transvaal Provinces
 - 3.2 Zimbabwe, Mozambique and Malawi
- 4 Aloes of the Central and Western Regions of Southern Africa
 - 4.1 Southern and south-western Cape
 - 4.2 The dry central regions (including south-western and southern Free State, and Botswana)
 - 4.3 Namaqualand and the north-western region of South Africa
 - 4.4 Namibia
 - 4.5 Angola

1 TALL EASTERN ALOES

A. barberae Th. Dyer (*A. bainesii* Th. Dyer): Discovered by Thomas Baines in 1873 near Greytown in KwaZulu-Natal. It is the largest and tallest (18 m) of the southern African aloes and the only tree aloe in the eastern region. Baines sent sketches, material and a description to Dr Hooker at Kew. Thiselton Dyer described the new species as *A. bainesii* in Gard. Chron. 568 (1874a). In the same publication he described *A. barberae* from 'Caffraria' (Transkei). Later realising that the two were conspecific, he published a note in the same journal (1874b) combining the two, and chose the name *A. barberae*. This note was overlooked and the species has been called *A. bainesii* for 120 years; it is a tragedy that a plant regarded as a living memorial to Thomas Baines, artist and explorer, should now undergo a name change (*Bothalia* 24(1), 1994). It is a widespread subtropical forest tree with rose-coloured terminal inflorescences (June) extending from the Eastern Cape to Mozambique.

A. marlothii Berger [colour p. 245]: Eastern Botswana, widely in Transvaal, Swaziland, northern KwaZulu-Natal, Mozambique. It does not cross the Limpopo into Zimbabwe, the Soutpansberg being the northern limit in the Transvaal. Up to 6 m tall, it is probably southern Africa's most stately aloe, and is nearest related to *A. spectabilis*, sharing with it the habit of a tall stem covered with old leaf bases, and large rosette of spiny leaves (when not in flower the two species are barely distinguishable). The racemes are 300-500 mm long, horizontal or nearly so, with secund orange to yellow flowers pointed back towards the main axis, while in *A. spectabilis* the racemes are 250 mm, erect to sub-erect, with flowers evenly placed around the axis of the raceme. Flowers from June to September. *A. marlothii* subsp. *orientalis* lies to the east of the distribution of the typical subsp. which prefers higher, cooler areas. Subsp. *orientalis* distinguishes itself by suckering to form several stems on sandy soils, has less or no spinescence on the leaf surface; it has shorter stems and racemes, the latter being oblique rather than horizontal. It occurs along the Mozambique coastline at Divinhe, and on seasand from Inhambane to Maputo. In Kwazulu-Natal it is in isolated communities southwards as far as Eshowe.

A. thraskii Baker: Grows on the sand dunes from just north of Durban in KwaZulu-Natal, southwards as far as northern Pondoland in the Eastern Cape. This is another stately plant with deeply channelled recurving leaves and tall, branching, densely-flowered golden-yellow inflorescences. The orange stamens are well-exserted and in the sun they seem to light up the raceme. Although it seldom ventures away from the first line of dunes it grows rapidly in



Aloe spectabilis

cultivation, and plants grown from seed thrive in inland gardens far from the sea. It flowers in June and July.

A. rupestris Baker [colour p. 245]: Occurs in tall bush in the hot river valleys from the Tugela River northwards through northern KwaZulu-Natal, Swaziland to Mozambique. This tall, slender-stemmed species (6-8 m) is never found in open spaces. The stem is simple, sometimes branched low down. The racemes are densely flowered, the buds and flowers spreading outwards and downwards; it is beautiful in August and September, with a striking orange-yellow bottle-brush effect but the flowers are short-lived. Affinities with *A. thraskii* and *A. excelsa* have been suggested.

A. excelsa Berger [colour p. 245]: Northern Province (Transvaal), Zimbabwe, Mozambique, and Zambia. A tall, slender-stemmed aloe (2-6 m) which can become very robust on cultivation. It was collected in the Matopos area near Bulawayo in 1903 by Rudolph Marloth. It is extremely handsome in bloom when 30 to 60 racemes are displayed in a high panicle. The magnificent candles of red buds remain spectacular for up to five weeks, only then breaking into flower, which proceeds rapidly, the whole flowering period lasting at least two months. Buds and flowers point downwards and flowering is from August to September. Orange, yellow, white and bicoloured racemes have been seen in the eastern districts of Zimbabwe (Kimberley, *Excelsa* 3, 1973) but the usual colour is red. In 1977 Leach described var. *breviflora* which occurs along the Ruvo River on the border between Malawi and Mozambique. It has very narrow, deeply canaliculate leaves and the flower perianth is about 10 mm shorter than that of the typical variety.

A. angelica Pole Evans: Soutpansberg in the Northern Province (Transvaal): Wylie's Poort north of Louis Trichardt. A beautiful, distinctive species (3-4 m) which in winter bears up to 20 densely capitate bicoloured racemes in red and yellow. Old leaf bases are attached on the upper third of the stem, the unbranched plants usually taller than the surrounding bush. Plants do not do well out of habitat.

A. castanea Schönl.: Mpumalanga and Northern Province (Transvaal): Middelburg, Lydenburg and Ohrigstad districts, Steelpoort and Olifants River valley. This is the tallest (3-4 m) of the 'bottle-brush' aloes, branching from near the base into

10-20 stems bearing rosettes of glaucous leaves. It is the only one of the group (*A. spicata*, *A. alooides*, *A. vryheidensis*) in which the open-mouthed flowers are pedicellate. The simple, twisting, tail-like racemes bear reddish-brown flowers brimming with dark nectar in June to August. The name 'castanea' means chestnut brown, and refers to the overall brown colour of the flowers and nectar. Apart from its robust, many-stemmed habit, the species strongly recalls *A. vryheidensis*.

A. spicata L.f. (*A. sessiliflora*): The 'Lebombo aloe' so-called because it extends along the Lebombo Mountains, occurs in Mozambique, Swaziland and Northern KwaZulu-Natal; also plentiful in Mpumalanga and the Northern Province. Reynolds (1950) wrote that 'the flowers of *A. spicata* (a dried specimen collected by Thunberg) bear a striking resemblance to those of *A. sessiliflora*' but because he thought that the Eastern Transvaal was a 'terra incognita in 1772' he abandoned his correct line of thought and upheld *A. sessiliflora* Pole Evans (1917)



Aloe castanea, flowers brooming with dark nectar

instead. This has since been corrected. The species is single to several-stemmed, up to 2 m tall; the spreading to slightly recurved, metre-long leaves are channelled, tail-like, green to red. Up to five simple inflorescences (600 mm) arise from a rosette, the racemes densely-flowered with a bottle-brush appearance, the sessile flowers small, wide-mouthed, yellow and full of dark nectar. The species extends into Zimbabwe along the Sabi valley escarpment in the Chipinga district, more than 200 km north-east of the nearest locality of the closely related *A. tauri*, the Zimbabwe bottle-brush aloe. See entry under 2.4.

A. alooides (Bolos) Van Druten (*A. recurvifolia*): The most striking member of the 'bottle-brush' group of aloes (*A. spicata*, *A. vryheidensis*, *A. castanea*, *A. tauri*). It has a fairly restricted distribution on the mountains of Mpumalanga (Eastern Transvaal). The stout single stem, covered with grey, twisted dead leaves, is topped by the graceful downward curving deeply channelled leaves (1.3 m). This habit is recalled in the unrelated *A. thraskii* on the Natal coast, and again in *A. helenae* of southern Madagascar (interestingly, the latter also has campanulate flowers – but other floral characters differ). The tall (1.3 m) candle-like simple inflorescence has a densely-flowered raceme of sessile green buds and yellow flowers, with pale nectar. The dense pine and gum forests in Mpumalanga render the hilltop habitats of *A. alooides* inaccessible, but one inhabited spot is easily reached: 'The Bonnet', a small hill at the turn-off to Pilgrims Rest about 5 km west of Graskop, where flowering commences in July.

A. arborescens Mill. [colour p. 245]: A dense, shrubby aloe 2-3 m tall; it is the most widely distributed of its genus in South Africa, extending along the mountain ranges (but also down to sea level) from Riviersonderend in the Western Cape to the eastern parts of the Transvaal, a range of more than 1600 km in South Africa alone; it occurs in Mozambique and eastern Zimbabwe, extending westwards to the Victoria Falls; in Malawi it grows at the top of Dedza mountain. It is common in cultivation, sometimes forming impenetrable hedges. The common form has scarlet flowers on a simple, conical or elongated-conical raceme, but there is a less vigorous form with yellow flowers. It flowers from May to June. A third form with a single stem of 1-2 m is reported to occur on Mount Mlanje in Malawi.

A. pluridens Haw. [colour p. 245]: Extends from Humansdorp in the Eastern Cape to Pondoland and KwaZulu-Natal. Similar to *A. arborescens*, but is generally a taller, more slender plant, simple or branched stems reaching up to 4 and 5 m in dense bush. Unlike the dull green leaves of *A. arborescens*, this species has yellowish-green, narrower leaves, the sap of which has a rhubarb-like odour. The inflorescence may have up to 4 branches; perianth colours are salmon or red, and, more rarely, yellow. It flowers from May to July.

A. lineata (Aiton) Haw. [colour p. 246]: Albany and Port Elizabeth districts, common in Howieson's Poort and Stones Hill (Grahamstown). A summer-flowering aloe with a simple or branching stem up to 2 m tall. Each rosette produces tall inflorescences (1 m) of salmon-pink flowers; the leaves have distinct lines on both surfaces. The typical variety flowers in February. Var. *muirii* occurs from Riversdale to Mossel Bay in the Western Cape and has bright yellowish-green leaves with lines better defined, slightly larger marginal teeth and flowers earlier, from June to November. Reynolds writes that *A. lineata* is closely related to *A. glauca*, but differs in having lineate (striped) leaves of a bright green colour.

A. africana Mill. [colour p. 246]: Eastern Cape, from Port Elizabeth to Port Alfred, especially along the Swartkops River, in the Addo Bush and north-west of Grahamstown. The 2-4 m stem is simple and covered with persistent dried leaves. It is probably the easiest to recognise of the tall aloes when in flower because of the markedly upward curve of the perianth tube. The beautiful inflorescence is 2-4 branched, the buds reddish, opening into yellow-orange flowers from July to September.

The following two species have a west to east distribution

A. ferox Mill. [colour p. 246] (*A. candelabrum*): A grand aloe (2-3 m) which marches across hills and valleys from Swellendam in the Western Cape to the Eastern Cape and southern KwaZulu-Natal, proceeding northwards across the Karoo into the Free State and Lesotho. In the Natal form (syn. *A. candelabrum*) the rosettes are larger and the mouth of the perianth is whitish. The spiny character of the leaves is variable: plants in the Western Cape tend to be smaller and spinier, while the

leaves of the taller eastern plants are sparsely spiny or smooth on both sides. The erect racemes are red, orange or yellow and white forms are occasionally found. Flowers from May to June along the coastal belt, from July to November inland. *A. ferox* leaves are harvested increasingly on farms, the aloe juice being an important source of water-soluble principles, in particular chrysophanic acid; the extracts are used in ointments which heal skin in the case of burns and sunburn.

A. speciosa Baker [colour p. 246]: Widely distributed from Swellendam in the Western Cape to Somerset East in the east; abundant in the Suurberg range and in the Fish River valley. Single-stemmed or branching from the base or higher, the rosettes always tilt to one side. Happiest when clinging to river valley precipices, this tall species (3-4 m) with its beautiful rose-tinted leaves and striking tri-coloured racemes is a fine garden aloe, especially when placed on its own. Flowering August to September.

A. munchii Christian: Occurs in the Chimanimani mountain range bordering eastern Zimbabwe and Mozambique. The stem (2-3 m) is very slender and bare as the old leaves fall away. The 2-3 branched inflorescence is most distinctive and easily recognised by its 'pagoda-like' capitate racemes of scarlet flowers which appear in July.

A. littoralis Baker [colour p. 246] (*A. rubrolutea*): Although this tall aloe occurs in the Northern Province (Transvaal), Zimbabwe and Mozambique,

its headquarters are in the west. It is very abundant on the coastal hills north of Luanda in Angola, as well as western Angola and Namibia, crossing to the east through Zambia and Botswana, always showing a preference for hot, dry low-lying areas. The species is 2-4 m tall, and produces a many-branched inflorescence of pale pink to deep rose flowers on narrowly cylindric acuminate racemes. In the east it appears to flower from February to March, in Namibia from July to August. Refer also to *A. esculenta* under 4.5.

A. mawii Christian [colour p. 246]: Occurs widely in Mozambique, and to the north in Malawi and Tanzania. Arborescent, 1-2 m tall, this is a striking species which has nearly horizontal racemes of glossy red secund flowers. It is possibly allied in this respect to *A. ortholopha*, but the latter is a stemless, compact plant with shorter, broader and thicker leaves. *A. mawii* varies greatly over its wide range: it occurs singly, with no stem, to shrubby with branched stems up to 3 m. Leach discovered in Mozambique that while *A. mawii* remained stemless at altitudes below 730 m, it developed stems when present at above 1200 m. It flowers from June to July.

2 SMALL TO MEDIUM EASTERN ALOES (EXCLUDING 'GRASS ALOES')

2.1 Eastern Cape and Lesotho

The following species occur in the Eastern Cape Province of South Africa, and Lesotho, but their wider distribution is also given.

A. striata Haw. [colour p. 246]: The typical subspecies extends from the Hex river valley in the Western Cape through dry karoo to the Eastern Cape as far as the Kei River valley. A beautiful decumbent species which forms an open rosette of pinkish-grey, usually striated, fleshy leaves which have a smooth red or pink border. The absence of marginal spines is most unusual. 1-3 branching usually flat-topped panicles of coral-red flowers appear from August to September. Two subspecies lie to the north: subsp. *komaggasensis* has a restricted locality in Namaqualand and subsp. *karasbergensis* occurs in the Northern Cape and southern Namibia (see under 4.3). Subsp. *striata* is one of the most popular garden succulents in South Africa.



Aloe munchii - one of several capitate racemes

A. reynoldsii Letty [colour p. 247]: Restricted to precipice faces and slopes in humid conditions along rivers east of the Kei in the Eastern Cape, particularly the Bashee River. It is very similar to *A. striata* but is distinguished from it by the H-shaped spots on its leaves, wavy, finely toothed margins and yellow flowers. It is widely separate from, but closely related to, *A. buhrii* of the west.

A. maculata All. (*A. saponaria*): The widely distributed 'soap aloe' extends from the Cape Peninsula to the Eastern Cape, KwaZulu-Natal, Lesotho, Swaziland, Zimbabwe (Inyanga). A stemless, handsome species which is the most variable of all the spotted aloes; the leaves are thickly fleshy, spreading-ascending with spiny margins; its densely capitate flowers come in shades of yellow, orange, pink and red. The inflorescence which is 400-600 mm tall in suckering plants may be taller in single specimens. Various forms from wide apart areas flower in winter, spring and summer. It is frequently cultivated, but because it suckers vigorously, plants are often added to garden refuse and dumped; this only adds to their further dispersal! The species was cultivated in Europe in 1732.

Haworth's Series *Macrifoliae* is represented largely in the Eastern Cape. These species have slender stems which often rely on support from other plants, narrow soft leaves with distant small marginal teeth, the leaf base ensheathing the stem, the sheath usually vertically striped. The inflorescences (flowers red or yellow) are lateral. While four of the species have an almost entirely eastern distribution, one of them, *A. commixta*, occurs in the south-western Cape and is noted under 4.1.

A. ciliaris Haw. [colour p. 247]: Eastern Cape; extends from Uitenhage to the Suurberg in a wide coastal and inland belt to the Kei River and Kentani. The *A. ciliaris*-*A. tidmarshii* complex was revised by Brandham and Carter (*Kew Bulletin* 1990), and consists of the following varieties: Var. *ciliaris* (hexaploid) has the largest flowers (perianth 28-35 mm long), the widest distribution in the area, and is easily recognised by the ciliate leaf base encircling the stem, projecting outwards like a fringed collar (cilia 2-4 mm long). Its handsome red flowers appear near the end of the long weak stems which climb and straggle through the undergrowth – it is a wonderful plant for the sheltered garden, quickly covering a fence, and flowering robustly in

most months of the year. Var. *redacta* refers to tetraploid plants growing at Qolora Mouth (north of Kei Mouth), on the sand dunes at the edge of low coastal forest, in which the leaf sheath cilia are 1-2 mm long; the flowers are smaller, the perianth 21-25 mm long. Var. *tidmarshii* (*A. tidmarshii*) occurs on the Suurberg, near Uitenhage and near Grahamstown. It is diploid; the leaf sheath cilia are minute, less than 1 mm long, the perianth is 16-23 mm long. The ciliate nature of the sheathing leaf base of *A. ciliaris* distinguishes it from the other members of the *Macrifoliae*.

A. tenuior Haw.: Distribution is from Somerset East in the Eastern Cape northwards to Tsolo, in a band which includes the coastlands; it is reported from the Pongola River area in northern KwaZulu-Natal. It possesses a large woody rootstock from which slender largely bare stems arise to a height (or length) of 1-3 m, leafy at the apex, with, typically, yellow flowers. The encircling leaf sheath is not ciliate. In dense bush the long stems are supported, in the open the stems are shorter. The racemes are variable, laxly to densely-flowered, the perianth 11-14 mm long, usually yellow, but along the coastline northwards from Kentani bright red flowers occur (var. *rubriflora*). The species has an extended flowering season, probably flowering in response to rain.

A. gracilis Haw.: The species lies to the west of *A. tenuior*, in thickets in Uitenhage and Port Elizabeth areas. Stems up to 2 m long, leaves dull green, the leaf sheath not ciliate. The inflorescence is simple or branched, the bright scarlet flowers distinguish the species by their length, 40-45 mm. Typically the plant is shrubby and erect, but var. *decumbens* in the Langeberg (Riversdale, Western Cape) is decumbent, with leafy stem ends ascending.

A. striatula Haw.: Distributed along the summits of mountains from Graaff-Reinet eastwards to Queenstown, Lady Grey and Lesotho. It is a robust, erect, branching shrub up to 2 m high, easily recognised by its shiny green leaves, the prominent vertical stripes on the leaf sheath and the densely-flowered racemes (150 mm long) of red buds opening into orange flowers. Var. *caesia* which occurs near Molteno has milky-green leaves and yellow flowers. Flowering period from November to December.

A. aristata Haw.: Eastern Cape, Free State, Leso-

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University Herbarium, pointed out that germination does not occur unless optimum conditions are present; young plants are almost a rarity and sometimes appear from inside the cushion-like *Euphorbia clavarioides*, the latter providing the microclimate that the seedling requires. Typical on a steep slope is the 'waterfall' of aloes: a rosette breaks loose from a cluster at the top of the mountain, rolls part of the way down the slope and then roots itself, later shedding more plants which tumble and re-root. The plants are often snow-covered in winter and have their shallow roots bathed in running water in summer. It is a sad reflection on man's acquisitiveness that all the sites for this aloe mentioned by Reynolds (1950) are now extinct, and wisely, known sites are no longer revealed. To remove this high-altitude aloe from its habitat nearly always results in its early death and further endangers the species. Due to the efforts of the Kirstenbosch staff concerned, it did grow, and flower, on the top of Table Mountain, but was later removed for its protection, as Table Mountain has become a hiker's paradise. The only way it should be introduced into a collection is by seed, and this is not easy to obtain.

2.2 KwaZulu-Natal and Swaziland

A. umfoloziensis Reynolds: A member of the maculate or 'spotted leaf' aloes, this species takes its name from its main habitat, the Black and White Umfolozi Rivers in northern KwaZulu-Natal. The plants are stemless or have a short stem bearing flattish, spreading, white-spotted leaves (250 mm) with dried tips. The sub-capitate inflorescence is similar to that of *A. maculata*, but the heads of coral-red flowers are smaller and the peduncle (up to 1.5 m) is taller. Reynolds considered *A. umfoloziensis* to be a link species between *A. maculata* in the south and *A. parvibracteata* in the north, and Jeppe suggests that it is probably a robust form of *A. maculata*. *A. umfoloziensis* is not included in *List of S.A. Succ. Plts.* (1997) but is recognised in *Guide to the Aloes of S.A.* (1996).

A. prinslooii Verdoorn & Hardy: A stemless, solitary or clustered maculate aloe from central KwaZulu-Natal, with white-spotted thick leaves ending in dried twisted apices, which, with the sharp marginal spines, provide effective protection for the plant. The conic-capitate inflorescence has a dense terminal cone of buds which open into small

creamy-pink flowers. The usual maculate aloe feature of the inflated perianth base is absent in this species. It flowers from June to October.

A. mudenensis Reynolds [colour p. 248]: This maculate species flourishes in the low, warm valleys near Mudén and in the Tugela and Mooi River valleys in KwaZulu-Natal. The bluish-green leaves are white-spotted with withered tips, and the older plants develop stems up to 800 mm. The handsome inflorescence branches into 4-8 round-topped cylindrical racemes of orange to red flowers, appearing in July.

A. greenii Baker: Extends from Pietermaritzburg northwards to southern Mozambique. Stemless, with slender, sub-erect, recurved leaves which are bright green and strikingly marked in white. It suckers to form large clusters in the shade under bushes in hot valleys. The tall, slender inflorescence is sparsely flowered in dusty-pink. It flowers in March and April.

A. pruinosa Reynolds: Pietermaritzburg district. A solitary maculate aloe with a short stem; the spreading leaves (700 mm) have H-shaped white marks. The name 'pruinosa' means 'covered with frost' and refers to the powdery bloom on the peduncle and brownish-pink flowers which are borne on a tall, branched inflorescence (2 m). Flowers from February to March.

A. dewettii Reynolds: Northern KwaZulu-Natal, Swaziland and near Piet Retief in Mpumalanga (south-eastern Transvaal). When in flower this species appears to be the tallest of the maculate aloes. It is solitary, stemless, and has glossy leaves up to 480 mm long, 130 mm wide at base, spotted above, unspotted below and with pungent brown marginal spines about 10 mm long. The tall inflorescence (2.75 m) of dull scarlet flowers has up to 25 racemes, flowering February to March. The perianth base in most maculate aloes is inflated, almost globular, in this species the base is 14 mm in diameter, the perianth up to 42 mm long. The species is found in open grassveld.

A. parvibracteata Schönl. (*A. parvibracteata* var. *zuluensis*, *A. keithii*, *A. komatiensis*): Northern KwaZulu-Natal, Mozambique, Swaziland, Mpumalanga (in Komatipoort area) and Zimbabwe. This rather unattractive aloe suckers freely to form large groups of stemless (in some localities stemmed) plants with

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roughly the same habit of spotted/lineate leaves with considerable die-back at the tips, a panicle from 600 mm-1 m tall, bearing racemes which are cylindric-acuminate (flowers spread downwards on the raceme, the bud region tapering to a point). The flowers are pink, and appear in June-August. Further described under the Zimbabwe aloes (see 2.4).

A. affinis Berger: Mountainous part of Mpumalanga near Graskop and Pilgrims Rest, in Elands River valley and near Rosehaugh and Sabie. The plant is solitary and usually stemless. The leaves are almost unspotted and lineate, a conspicuous character is the dark brown margin with 5-8 mm horny dark teeth. Up to three well-branched inflorescences develop, with uniformly red flowers in cylindric or sub-capitate heads, flowering May-June.

A. immaculata Pillans: Pietersburg and Lydenburg districts. As its name suggests, it has unspotted leaves which are lineate. It is a solitary, non-suckering species, the inflorescence (1 m) has 6-10 branches of coral-red flowers. There is potential synonymy here: Reynolds points out that between Chunies Mountain and the Olifants River *A. immaculata* and forms of *A. greatheadii* occur together with "a bewildering range of leaves, racemes and flowers". Like its allies, it flowers in winter.

A. dyeri Schönl.: In shady localities from Piet Retief to Barberton in Mpumalanga. A solitary, graceful aloe in which the long canaliculate leaves form a very large rosette up to 2 m in diam. Stemless or with a short stem, the rosette is the largest among the maculate aloes (Reynolds 1950). It produces 1 to 2 well-branched inflorescences (1.5 m) which bear brick-red flowers from February to March.

A. fosteri Pillans: Mpumalanga and Northern Province: occurs in fairly open flat country in tropical bushveld, west of the Drakensberg from Lydenburg to the confluence of the Steelpoort and Olifants Rivers. This well-proportioned aloe flowers in March and is the most attractive member of the maculate section. The bluish-grey leaves (400 mm) have a powdery bloom and confluent H-shaped spots. The tall 1.5 m inflorescence branches into 15-30 racemes which range in colour from scarlet to yellow; clear yellow is very unusual in the maculates.

A. vogtsii Reynolds: Occurs in long grass or bushes in the mist belt along the top of the Sout-

pansberg in the Northern Province. A graceful species with bright green leaves which have white H-shaped marks on the upper surface and speckled with green dots below; the inflorescence (660 mm) branches and rebranches, ending in broadly cylindrical racemes of scarlet flowers, from March to April. At the centre of the raceme the pedicels (18 mm) hold the buds horizontally. Photographs of *A. vogtsii* in *Guide to Aloes of S.A.* (1996) show flattened capitate racemes, unlike Reynolds's description; a maculate aloe with capitate racemes in the same vicinity (Franshoek, north-east of Louis Trichardt) is *A. petrophila*; Reynolds records that a natural hybrid of these two species was found by Mr Vogts at this locality.

A. lettyae Reynolds: This solitary aloe grows in dense grass and among bushes on the mountain slopes in the Duiwelskloof and Magoebaskloof areas of the Northern Province. Reynolds named this species after its discoverer, Cythna Letty, who devoted her life to superb illustration of the South African flora. This species has an unremarkable habit of erect-spreading spotted leaves, the inflorescence 1.75 m. It is distinguished by the prominent globular swelling (11 mm across) at the base of the perianth and the rounded curve of the branches of the inflorescence which bears rose-red flowers from February to April.

A. zebrina Baker (*A. ammophila*, *A. laxissima*, *A. transvaalensis*, *A. vandermerwei*): *A. zebrina* is the most widely spread of the maculate group. The greatest numbers occur in Angola from where the species fans out into Namibia, Botswana, Zambia, Malawi, Zimbabwe, Mozambique and South Africa in which last country it takes in the above synonymy. It usually suckers to form groups, leaves vary from long and narrow to triangular, with whitish blotches in transverse bands. The much branched inflorescence (1.5 m) produces laxly flowered racemes of pink to reddish flowers in the summer. The name *transvaalensis* was applied to the populations from Standerton to Pretoria and westwards to Serowe in Botswana. These plants have dull whitish-green spotted leaves and produce a tall inflorescence which branches into about 8 sub-erect limbs; the buds are grey-striped, the flowers pink to red. The plants from Bandelierkop to Warmbaths were represented by *A. ammophila*, being much smaller than the southern group, the inflorescence branching widely from the middle, intensifying the colour to a deep pink cloud. The linear-leaved form

of *A. zebrina* which grows in the bushveld 65 km east of Tzaneen was *A. vandermerwei* in the Reynolds's classification, but Reynolds himself realised that the tall branching inflorescence with flesh-pink flowers related it to *A. transvaalensis*. The greater distribution and variability of *A. zebrina* was, in 1950, not taken into account in the description of South African species, nor, strangely, was the connection realised by Reynolds in 1966, in *The Aloes of Trop. Africa and Madagascar*. See also the entry under Angolan aloes (4.5).

A. burgersfortensis Reynolds: Lydenburg district, Burgersfort and Steelpoort River valley. Present in low-lying, hot areas, the species is either solitary or in small clusters. In the typical form the leaf (300 mm with a dried tip) is unspotted below, the inflorescence is sometimes slightly more than 1 m tall, well-branched and carrying 12 or more laxly flowered racemes in red. It flowers in June and July.

A. simii Pole Evans: Concentrated in the White River area and spreading to the Sabie River valley. This distinct species is stemless, solitary and grows in long grass. It has deeply channelled leaves (600 mm) which vary from bright green to milky-green, the surface usually unspotted. The inflorescence (1.5 m) branches and rebranches, carrying up to 15 long laxly flowered racemes of pink flowers which appear in February to March.

A. monotropa Verdoorn: Northern Province. The plant has a trailing stem which gives rise to offshoots; the thick leaves are spreading, recurved, forming a rosette which measures up to 600 mm across. The inflorescence branches and rebranches up to 800 mm, with laxly flowered racemes of reddish-pink flowers in November to December. This species is included at the end of the Transvaal maculate aloes because while it meets the requirements of spotted leaves and an inflated base to the perianth, its flowers tend to be secund, which shows an influence quite outside the maculate field.

A. parvibracteata Schönk.: Occurs near Komatipoort in Mpumalanga. It is described under the KwaZulu-Natal and Swaziland aloes (2.2).

(End of Transvaal maculate aloes)

A. pretoriensis Pole Evans [colour p. 248]: Gauteng, Mpumalanga, Northern Province, Swaziland and Zimbabwe. The plant is solitary, with a stem

up to 1 m supporting a dense head of greyish-green leaves. In May this elegant species is easily distinguished by its single inflorescence, 6-8 branched, which reaches a height of 2-3.5 m. The racemes (300 mm) are conical to acuminate, ending in long narrow points, the buds covered by bracts and the open flowers rose-pink. In the Transvaal *A. pretoriensis* often cohabits with *A. aculeata* but does not appear to hybridise with it.

A. thorncroftii Pole Evans: On mountain slopes near Barberton in Mpumalanga. This species is solitary and almost stemless; it is very closely related to *A. supraciliata* but is distinguished by its broader reddish-green leaves, longer racemes which are up to 500 mm (in *A. supraciliata* the racemes are up to 250 mm) laxly flowered, and the perianth is longer. It has a select habitat, and flowers in September; *A. supraciliata* flowers in May.

A. supraciliata Pole Evans: The range of this aloe only just enters Mpumalanga on the mountains south of Barberton. Refer to its description under 2.2.

A. cryptopoda Baker [colour p. 248] (*A. wickensii*): Covers a great range from Malawi to Zimbabwe, Mozambique and South Africa, in which country it extends in a broad band from Zeerust in the west to Lydenburg in Mpumalanga. The distinctive large compact rosette is easily recognised; the dull grey-green or pale glaucous smooth leaves, broad at base, taper to long points which often incurve, giving the rosette a pear or flask shape. The inflorescence (1.75 m) has up to 8 branches, the racemes vary from narrow and pointed to cylindrical-conical, the floral bracts very wide. There are three colour forms: red, bi-coloured red and yellow (*A. wickensii*), and yellow, from the Ohrigstad district. It is winter flowering.

A. lutescens Groenewald: Northern Province, in the bushveld from the Soutpansberg northwards to the Limpopo River. In Zimbabwe it grows along the Nuanetsi River. This is very similar to *A. cryptopoda* but is a smaller species which always suckers and has greenish-yellow leaves which are susceptible to sunburn. It would be difficult to distinguish its inflorescence from that of the bicoloured forms of *A. cryptopoda*. In south-east Zimbabwe *A. cryptopoda* grades into *A. lutescens* just north of the Limpopo River. There seems to be little justification for maintaining specific status for the suckering form.

A. globuligemma Pole Evans [colour p. 248]: Transvaal (Northern Province and Mpumalanga), Botswana and Zimbabwe. This is a very wide-spread species, often associated with river courses. The name of this remarkable stemless aloe refers to its second globular buds situated on spreading, obliquely horizontal racemes. Purple stamens emerge from the pink and yellow flowers, making the inflorescence even more dramatic. It is nearest related to *A. mawii* and *A. ortholopha*, with which it shares the second flower habit, and the near horizontal racemes, but differs in having globular buds. It is also, unlike most aloes, poisonous. Flowers in July and August. See entry under 2.4.

A. aculeata Pole Evans [colour p. 249]: Transvaal (Northern Province and Mpumalanga), Botswana and Zimbabwe. True to its name, this prickly species is not easy to handle! The spiny leaves vary from green to grey; north of the Soutpansberg and in Zimbabwe the leaf spines arise from white tuberculate bases. The plant is usually stemless, producing a neat and handsome inflorescence (1.3 m) which often divides into three, the orange and yellow spikes giving a delightful candelabrum effect. It flowers from May to July.

A. petricola Pole Evans: In the vicinity of Nelspruit and Sabie in Mpumalanga. The species is related to, but distinct from, *A. aculeata*. It is one of the finest of the Transvaal aloes, and well worth cultivating. The plant is stemless or very short-stemmed. The grey leaves (600 mm) are glabrous or sparsely spined; the inflorescence (1 m) has 2-4 branches, the racemes are closely covered with red buds which open into greenish-white flowers, giving a beautiful bicoloured effect; flowering from July to August. It occurs in great numbers on the hills 3 km east of Sabie.

A. reitzii Reynolds: Restricted to small areas near Belfast in Mpumalanga and northern KwaZulu-Natal. A handsome species which has a single, stemless or short-stemmed rosette of glaucous-green smooth leaves which end in hard sharp points. The inflorescence (1.3 m) divides low into 2-6 branches, the racemes densely multi-flowered, the bright red flowers are adpressed and overlapping, like tiles on a roof, and turn yellow when mature. In general habit this species resembles *A. gerstneri*, *A. petricola* and even the spiny-leaved *A. aculeata*, but is distinctly separated by its long (50 mm) curved perianth. The typical variety which occurs

near Belfast flowers from February to March, while var. *vernalis* flowers from August to September (spring). Var. *vernalis* has smaller floral bracts and smaller capsules; it occurs in the Vryheid district in KwaZulu-Natal.

A. chabaudii Schönl.: Has a wide central African distribution and is present in Northern Province and Mpumalanga. See under 2.4.

2.4 Zimbabwe and Mozambique

A. greatheadii Schönl. [colour p. 248]: Abundant throughout Zimbabwe. It is also present in Mozambique, the Northern Province in South Africa and Botswana. This species, which is a maculate aloe, is widely distributed and variable. The typical spotted rosette is almost stemless, solitary, or suckering to form clusters. The leaves are dark green and spotted above, paler and unspotted below. One to three branched inflorescences appear at once, varying in height from 1.35 to 1.75 m, bearing pale pink, white-striped flowers in acuminate or sub-capitate racemes. June is the main flowering month; in Nyanga it flowers in April. A true capitate form occurs near Mutare in Zimbabwe. The species is resistant to veld fires and survives in open grassland. Var. *davyana* refers to a large complex of forms in South Africa (see under 2.3), most of which have cylindric-acuminate racemes. The typical variety has racemes which vary from long (300 mm) and lax to capitate. "Sometimes two plants each exhibiting a different raceme may be found side by side" (O. West 1974).

A. swynnertonii Rendle (*A. chimanimaniensis*): With its headquarters in eastern Zimbabwe, this stemless large species also appears in the Soutpansberg and Waterberg Mountains in the Northern Province of South Africa, in Mozambique and Malawi. It was discovered in the Chipinga district in 1907 by Charles Swynnerton, a natural historian who collected extensively in eastern Zimbabwe and Mozambique. The species is maculate, the leaves may attain a length of 1 m. The inflorescence is a tall branched panicle up to 2 m, with densely capitate racemes. The flowers are red to salmon-pink, appearing February to April in Zimbabwe and May to July further south.

A. suffulta Reynolds: In Zimbabwe this aloe occurs at the confluence of the Sabi and Lundi Rivers

at Gona-re-Zhou. In Mozambique the type material was collected near Vila Luiza. It also occurs in northern KwaZulu-Natal. An unusual small aloe which clings to coastal and riverine habitats, producing long, narrow, dark green, recurved leaves (500 mm) with both leaf surfaces spotted. Unique is the very long fragile peduncle (1.75 m) which climbs through bushes, which ultimately support the 7-8 laxly-flowered racemes of pendulous pale red flowers. A colony of this species found by Alan P. Lancaster south of Mount Selinda spread by means of base off-shoots. Unlike most maculate aloes, the flowers of this species do not have a globular base to the perianth.

Other maculate aloes which occur in Zimbabwe are: *A. maculata*, *A. parvibracteata*, and *A. zebrina*.

A. christianii Reynolds: Widespread in Zimbabwe, Mozambique, Zambia, Malawi, Angola and Tanzania. Growing in grassland the species is subject to annual fires which seem to stimulate growth; it does not thrive in cultivation. The species was named after Basil Christian, on whose farm near Harare the type material was collected. A few years before his death in 1951 he bequeathed his farm 'Ewanrigg' and his fine aloe collection to the nation. *A. christianii* is usually solitary, its rosettes of unmarked leaves are up to 900 mm across. The tall, narrow inflorescence (2-3 m) is similar to that of *A. pretoriensis*, but the species can be distinguished by its tiny floral bracts (6 mm) and the flowers have shorter pedicels. In Zimbabwe it flowers from May to June.

A. tauri Leach [colour p. 249]: Belingwe district in Zimbabwe. A 'bottle brush' aloe discovered by E.J. Bullock near Mnene Mission, it closely resembles *A. spicata* which occurs separately in the Chipinga district. The stark, exposed locality of *A. tauri* may have led to the natural selection of certain features like the smaller, low clustered habit, the slightly shorter raceme and the reddened, decurved leaves; the taller, more luxuriant *A. spicata* is nearly always found in cooler escarpment areas in tree and bush shade. Reynolds mentions in *The Aloes of South Africa* that, in exposed parts of the Lebombo Range, *A. spicata* is more shrubby and has shorter racemes.

A. chabaudii Schön! [colour p. 249]: Zimbabwe and widely in central Africa. In South Africa it occurs in the Northern Province, Mpumalanga and

northern KwaZulu-Natal; it is also present in Swaziland. This grey-leaved stemless aloe has in the typical variety a slender panicle bearing up to 20 cylindric racemes of scarlet flowers; the base of the perianth is inflated. It is a common sight on granite koppies in Zimbabwe, the centre of its distribution. Var. *mlanjeana* from Malawi has an interesting oblique inflorescence with its pink or orange racemes almost horizontal. Var. *verekeri* from the Sabi Gorge in Zimbabwe and Vila de Manica in Mozambique has sub-capitate racemes in shades of yellow, orange and red, the leaves olive-green with reddened tips. Flowering in winter – July. Often reminiscent of the *A. striata* complex in the south, it shares the ability of the latter to become a cliff-dweller: West (1974) describes the 'Zambesi Gorges' form, with a pendent inflorescence, sparsely flowered; the 'Chizarira Escarpment' form with a small rosette, also pendent.

A. ortholopha Christian & Milne-Redhead [colour p. 249]: Along the hills of the Great Dyke for about 130 km from the Great Dyke Pass north-eastwards to almost the Zambesi escarpment. A stemless, solitary aloe which produces an inflorescence (800-900 mm) with 2-3 almost horizontal racemes, densely flowered in shades of orange to red. The flowers are secund (close behind each other and on one side of the peduncle). This aloe is endemic to Zimbabwe and is adapted to the high mineral content of the serpentine soils of the Dyke, which holds the world's largest deposit of chrome ore. When removed from its habitat, this unique and beautiful species starts to deteriorate, but additions of magnesium sulphate and agricultural lime to the soil are beneficial. Allied to it is *A. mawii*, of Mozambique, described earlier with the tall eastern aloes.



Secund flowers of *Aloe ortholopha*

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the slender inflorescence, only the cylindric raceme of pale yellow flowers turns upwards.

A. crassipes Baker: The wide distribution of this inconspicuous aloe is more central than eastern; it was first collected in the south-western Sudan, evidence points at its distribution being continuous through Upper Zaire, Kivu and Shaba (Katanga), to Zambia, where it occurs in the Western Province, on the Angolan border. It is a dull, greyish-green almost stemless species with unspotted leaves. The branched inflorescence (500-600 mm) ends in cylindric-conical racemes of yellowish-green flowers. Flowers January-March. The plants in Zambia grow in grassland and all collectors mention its inconspicuous habit.

3 THE GRASS ALOES OF SOUTHERN AFRICA

The name 'Grass Aloe' is so widely used, and so aptly descriptive of the smaller soft-leaved species which often resemble and live with the grasses, that it is used here to include the *Leptoaloes* as well, and not only Reynolds's *Graminaloes*. The section *Graminaloe*, which covers a handful of species, is an artificial one. Its one distinctive feature, the bilabiate corolla mouth, is not shared by all its members, and it is difficult to decide what feature sets *A. minima* apart from the *Leptoaloes*.

If the soft-leaved aloes of southern Africa are regarded in their entirety, it becomes apparent that only one variable feature has geographical significance: The species south of the Limpopo possess a capitate inflorescence while north of the Limpopo (mainly in the mountains of eastern Zimbabwe, the capitate form is almost absent; instead there is a cylindric-acuminate or laxly elongate raceme. There are a few exceptions and intermediates. The only true capitate species north of the Limpopo is *A. myriacantha*, which extends from the Eastern Cape in South Africa to Uganda. Among the South African species, all are capitate except *A. cooperi*, which is broadly conical, *A. inconspicua* which is cylindrical, while *A. kniphofioides* and *A. soutpansbergensis* are laxly elongate. Intermediates appear to be *A. modesta* and *A. integra* which have short, cone-like inflorescences. It seems that the influence producing the capitate arrangement remains south of the geographical barrier of hot lowveld which separates these small eastern aloes into a southern temperate group and a northern tropical group.

3.1 Eastern Cape, KwaZulu-Natal and the Transvaal Provinces

The following species have narrow leaves

A. myriacantha (Haw.) Schult. & J.H. Schult. [colour p. 249]: This species has a truly remarkable distribution from Grahamstown in the Eastern Cape through KwaZulu-Natal to Zimbabwe and north to Uganda. Obviously this little plant with narrow leaves not more than 300 mm high is in perfect agreement with a changing environment. The simple inflorescence is capitate, bearing pinkish-grey or greenish-white flowers in which the perianth mouth is 2-lipped and upturned. In the Eastern Cape it flowers in February.

A. albida (Stapf.) Reynolds: At 1 600 m on mountains in the vicinity of Barberton in Mpumalanga. This miniature species is only 150 mm high and thrives in the mist belt. It is solitary or forms a tufted cluster; the inflorescence is capitate, and the white flowers, as in *A. myriacantha* are bilabiate and upturned at the mouth. It flowers from February to April.

A. saundersiae (Reynolds) Reynolds: Found on the hills in central KwaZulu-Natal where it enjoys a good summer rainfall and mists. It is related to *A. albida* and is the smallest aloe in southern Africa. It has similar habit to *A. albida*, but is smaller and the capitate inflorescence bears creamy-pink flowers which are not bilabiate. It flowers from February to March.

A. minima Baker: Solitary in many grassy areas of KwaZulu-Natal, Mpumalanga and Swaziland. The sparse, erect rosette of linear leaves is about 300 mm tall, the leaf bases are spotted and faintly spinescent; the simple inflorescence (300-500 mm) is densely capitate with dull pink flowers; var. *blyderivierensis* of Mpumalanga has distichous leaves and is more robust than the typical variety, producing an inflorescence up to 600 mm tall.

A. parviflora Baker: This is a doubtful species: The description by Berger is apparently of a specimen collected near Pinetown in KwaZulu-Natal. Although nearest to *A. minima*, Berger's drawing clearly shows blunt leaf-ends; the leaf surface according to Reynolds is rough (tuberculate). The leaves of grass aloes become necrotic distally, and

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the Little Karoo eastwards to Grahamstown. (With the new provincial boundaries, this is the only grass aloe in the Western Province!). The species shows a preference for poor soils and is the only grass aloe present in fynbos habitat. It is usually solitary and is found in dry, sandy places. The rigid leaves (500 mm) are spotted on both sides with white on yellowish-green; the leaf is U-shaped in cross-section. The capitate inflorescence has relatively large flowers (perianth 38 mm long) which are salmon-pink and appear from November to February.

A. cooperi Baker: Distributed from the warm coastal areas along southern KwaZulu-Natal to colder mountainous regions in Swaziland and Mpumalanga. The plants in the coastal belt are robust and reach up to 1.5 m while those growing inland are much smaller. The older plant produces a stem up to 180 mm with numerous side shoots. The leaves are distichous, easily distinguished by their keel, and are V-shaped in section. The raceme is a long cone of large salmon-pink or pale orange flowers which are green at the mouth. The typical subspecies flowers from December to February. Subsp. *pulchra* flowers later, in April-May, its leaves are thicker and not serrate for 3/4 of their length. Its distribution is limited: south of Richards Bay in KwaZulu-Natal and in Umbeluzipoot in Swaziland.

A. chortolirioides Berger (*A. chortolirioides* var. *boastii*): Occurs on the mountains of Swaziland, Mpumalanga and the Northern Province. The short stems branch and form dense tufts of 30-50 'heads' to one plant; the narrow linear leaves are erect and 100-250 mm long; the dried, brown leaf bases are persistent on the lower stem. The capitate racemes have 18-20 scarlet flowers tipped with green. The author has found that by packing dried grass around the plants and watering liberally (without firing the grass) the plants can be coaxed to flower in July. Larger plants are now regarded as var. *woolliana* (*A. woolliana*); the leaves of this variety measure up to 400 mm long and 8 mm wide (Glen & Hardy, S.A. J. Bot. 1987).

A. dominella Reynolds [colour p. 250]: Central KwaZulu-Natal. Another tufted species, the short stems covered with dead leaf bases; both the leaves and the simple inflorescence are about 350 mm long. Its habit is similar to that of *A. chortolirioides* but it can be distinguished from the latter by its



Aloe microcantha

Aloe cooperi



Aloe chortolirioides

Aloe dominella



much shorter yellow flowers (perianth 18 mm compared to over 30 mm in *A. chortolirioides*). It flowers from July to October.

A. soutpansbergensis Verdoorn: Occurs in the Northern Province on moist south-facing rocky slopes of the Soutpansberg. It is a small species with soft succulent leaves which are often pendulous; the leaves are light green, narrow and well spotted at the base. The simple inflorescence is sparsely-flowered in orange-red, with up to 8 flowers which appear in January.

A. nubigena Groenewald: Its name 'born of a cloud' indicates the kind of habitat it chooses and it does not take kindly to the average garden. It forms clusters on damp rock faces near waterfalls on the Drakensberg escarpment in Mpumalanga. The linear leaves (300 mm long, 15 mm wide) hang down over the rocks, the capitate inflorescence curving upwards, bearing scarlet flowers with green tips. The flowers appear from November to March.

A. thompsoniae Groenewald: Another 'cloud and mist' aloe which grows at the top of the Wolkberg in the Northern Province. Unlike some of its relatives, there is no difficulty in identifying this little aloe: the leaves are less than 200 mm long, 15 mm wide at the base, spreading with recurving tips to form a rosette. Several short inflorescences appear from December to January bearing large pyramidal clusters of bright orange flowers. The plant suckers readily when grown in semi-shade in rich, loose soil under moist conditions.

A. verecunda Pole Evans: Mostly recorded from the Witwatersrand Ridge in Gauteng but also further afield in Mpumalanga and east of Pietersburg in the north. The species prefers rocky, sloping ground. The leaves (300 mm) are usually distichous, sometimes spiralled, the upper surface channelled (but not V-shaped in section), the margins softly dentate. The plant often branches at ground level forming a group, the linear leaves die back in the dry winter. The inflorescence is densely capitate and the scarlet green-tipped flowers are carried well above the leaves. It flowers during summer.

A. vossii Reynolds: On the southern slopes of the Soutpansberg in the Northern Province. The floral characters of *A. vossii* closely resemble those of *A. verecunda*, but the species is distinguished by its longer, yellowish-green leaves (500 mm) which are rosulate, not distichous as in *A. verecunda*. The fleshy leaves are channelled, copiously spotted at the base. The inflorescence (500 mm) appears from February to March, the raceme densely capitate, the perianth scarlet.

A. fouriei Glen & Hardy: Pilgrims Rest district in Mpumalanga, on the south-eastern aspect of steep slopes. Solitary or in semi-erect small tufts; stemmed up to 150 mm, covered with old leaf bases, the leaves distichous, channelled, up to 350 mm long, with dentate margins. The inflorescence is capitate with about 20 orange-yellow flowers, green-tipped. The perianth is 35-40 mm long, 11-13 mm across at the base, 6-8 mm across at the mouth, the segments thick and fleshy, the perianth is clearly triangular.



Aloe soutpansbergensis



Aloe verecunda



Aloe vossii

Hidden page

on the Chimanimani and Inyanga Mountains along the eastern border. In Malawi it occurs on the Kirk Range. See entry under 3.1.

A. ballii Reynolds [colour p. 249]: Enjoys a high rainfall on rock faces at 300 m in the Haroni Gorge at the southern end of the Chimanimani Mountains in Zimbabwe. It is a resilient species and does fairly well on a rockery when given some shade, even when not watered regularly; ideal for a shaded water garden, it should overhang rocks. The pale, greenish-yellow, long-spotted leaves are linear, distichous but sometimes the stem twists, giving a spiral effect. The plant branches repeatedly from the base. In cultivation it flowers almost the whole year round, producing orange cylindric flowers on a long, thin, leaning peduncle (500 mm). The flowers strongly recall those of *A. bellatula* of Malagasy, but while the latter has its perianth joined for half the length of the tube, in *A. ballii* the perianth segments are free to the base. In 1998 the description of var. *makurupiniensis* Ellert appeared in the *Cact. & Succ. J. (US)* 70. This is an upright form of *A. ballii*, with short, erect stems, leaves erect for more than half their length, the inflorescences fully erect. While var. *ballii* has a restricted location, the new variety grows in the lower gorges of the Chimanimani and is widespread over a range of about 36 km in Zimbabwe and Mozambique in the vicinity of the Makurupini River. The two men who were involved in investigating the distribution of the new variety in wild and remote country were Anthon Ellert and Voytek Popiel, both aloe enthusiasts of Zimbabwe.

A. wildii (Reynolds) Reynolds: In mountain grassland among rocks on both sides of the Chimanimani Range: In the Melssetter district in Zimbabwe and in Mozambique. A small species with up to 8 distichous leaves, sending up several simple inflorescences of bright orange-scarlet flowers which are laxly arranged. It is not easily cultivated. It flowers from September to November.

A. howmanii Reynolds [colour p. 250]: Chimanimani Mountains in the Melssetter district of Zimbabwe. It extends from Bundi Gorge northwards for 16 km to the Musapa Gap. An extraordinary and seldom seen species which grows on high, vertical, south-facing cliffs. The thickened leaves are 15 mm wide with a translucent border and blunt apex. It is the leaf habit which is distichous, narrowly strap-shaped with almost entire margins, and

a markedly obtuse apex which distinguishes the species from related species. The inflorescence (250 mm) hangs down, with the raceme of scarlet flowers upturned, flowering from April to June.

A. musapana Reynolds [colour p. 250]: In Zimbabwe it occurs on south-east vertical rock faces on Musapa Mountain and the hills southwards to Melssetter. It was discovered by Mr Ted Bullock in 1960. The stem branches repeatedly to form heads of about 7 distichous linear leaves. The inflorescence (400 mm) curves upwards with striking scarlet or orange flowers in a cylindric-acuminate raceme 150 mm long. It is easily cultivated and should be allowed its natural pendulous habit. It will tolerate full sun and when well watered it flowers continuously for most of the year.



Aloe ballii



Aloe wildii



Aloe musapana

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keeled on the back and spotted at the base. The laxly-flowered inflorescence is 300–450 mm tall, the raceme varying from cylindric-conical to subcapitate. The brilliant orange-red flowers have been seen at intervals from July to February.

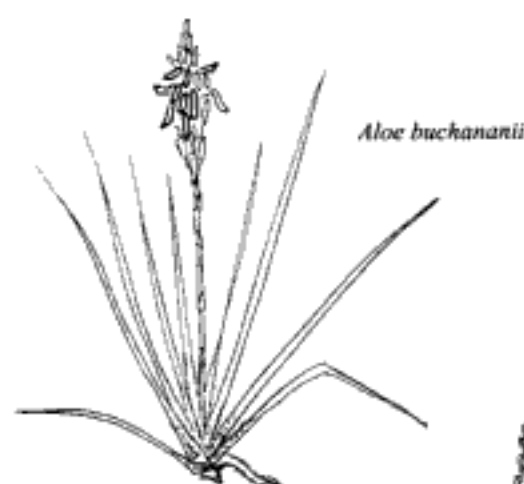
A. cannellii Leach [colour p. 250]: Manica e Sofala district in Mozambique. Occurs among grasses on the south-eastern almost vertical cliffs of the mountain tops. This tiny tufted aloe was described in 1971 by Leach who named it after his friend and travelling companion, I.C. Cannell. It has a spreading or pendent habit, the narrow leaves up to 260 mm long, 4–8 mm wide; the laxly-flowered erect inflorescence is 200–300 mm, with reddish-orange, green-tipped flowers. It seems to do well on a dry, rocky incline.

A. torrei Verdoorn & Christian: Mozambique: Apparently restricted to the western granite slopes of Namuli Peaks situated about 270 km north of Quelimane. It resembles *A. chortolirioides* in habit, pro-

ducing a mass of densely-tufted stems, but differs from the Transvaal species in having longer leaves (up to 450 mm) which are so limp that they hang downwards, and a taller inflorescence with a lax raceme of scarlet flowers, greyish-green at their tips.

A. buchananii Baker: Malawi (although Malawi succulents are not included in this survey, this species is mentioned here to complete the picture of African grass aloes). A robust plant (with the habit of a Red Hot Poker) which has leaves (600 mm) distichous or becoming rosulate, and 50 mm across at the base. The inflorescence is 600–800 mm tall and the flowers are pinkish-red. The perianth is broad at the base, 12 mm across, and narrow at the mouth, which feature is not apparent in the longer flowers of the closely related *A. nuttii*; the outer perianth segments are free. The plants flower from April to May.

A. nuttii Baker [colour p. 251]: Widely distributed



in Zambia, Angola, Malawi and Tanzania, with its type locality 16 km east of Abercorn in Zambia. The species varies from a single plant to tufted clumps of up to 12 stems in which the leaves, which are always rosulate, become narrower. The leaf margins are softly denticulate, especially in the lower part of the leaf, which is also heavily spotted. The inflorescence is similar to that of the related *A. buchananii*, but the perianth does not narrow towards the mouth as in the latter species, and there is a variable amount of fusion along the length of the outer perianth segments. Flowering from January to March.

4 ALOES OF THE CENTRAL AND WESTERN REGIONS OF SOUTHERN AFRICA

4.1 Southern and south-western Cape

A. haemanthifolia Berger & Marloth [colour p. 251]: Probably owes its survival to its inaccessibility on the highest peaks of the mountains of the south-western Cape, from Stellenbosch to north of Ceres, at altitudes of 1000 to 1500 m. The plants sucker to make large stemless clumps appearing at grass level among the rocks in scanty soil on high ledges, where they enjoy frequent mist, a high rainfall and snow in the winter. The strap-shaped, distichous leaves (180 mm) have a red margin; the inflorescence (450 mm) is capitate with scarlet flowers which appear from October to December. The leaf arrangement is very similar to that of its neighbour, *A. plicatilis*, another mountainous species.

A. plicatilis (L.) Mill. [colour p. 251]: Occurs on the mountains of the south-western Cape, from Franschhoek to Elands-kloof. It is particularly well known on the Du Toit's Kloof Pass where it flowers from August to October. A striking arborescent shrub 3-5 m tall, it has smooth grey stems which branch dichotomously and end in fans of distichous leaves. The simple inflorescence (500 mm) ends in a cylindric raceme of scarlet flowers. It is easily grown from seed but rather slow-growing.

A. commixta Berger: South-western Cape: On the mountain tops in the Cape Peninsula, and westwards towards Caledon. As number 14 in Oldenland's herbarium, this species was one of the earliest to be cultivated in the Dutch East India Company's garden at the Cape. It forms a branching

bush with stems about 1 m tall, the inflorescence (350 mm) ends in a sub-capitate raceme of reddish buds opening into orange to yellow flowers. This is the only western member of Haworth's *Macrifoliae*, the related species can be found with the Eastern Cape species (under 2.1). It closely resembles *A. striatula* of the Eastern Cape, but the latter has much longer racemes, glossy deeper green leaves and a prominently striated leaf sheath. *A. commixta* flowers from August to September.

A. succotrina Lam.: South-western Cape: On steep mountain slopes of the Cape Peninsula, Hangklip and Hermanus. It varies from a solitary plant to dense patches in which the stemless young plants later become procumbent with stems up to 2 m long. The leaves (500 mm) are fairly narrow and tapering, with scattered white spots and a pale border which is firmly dentate. The simple inflorescence (1 m) bears glossy red flowers and purplish bracts. The name 'succotrina' meaning 'full of sap' gave rise to much confusion about the origin of this species, as the early writers assumed that it came from the Island of Socotra. Its natural habitats on the summit of the Karbonkelberg near Hout Bay and on Table Mountain are difficult to reach, whereas at Kleinmond it grows in among the littoral scrub. It flowers from July to August.

A. microstigma Salm-Dyck [colour p. 251]: Widespread from the south-western Cape to Albany in the Eastern Cape; common in the Little Karoo and southern parts of the Great Karoo. Usually short-stemmed, this well known aloe has a graceful rosette of green to reddish white-spotted leaves (300 mm), the margins with pungent spines. Several simple inflorescences (800 mm) are produced, usually bicoloured in red and yellow, or unicoloured red or yellow. On leaving Robertson on the McGregor road in July the hillside on the left is aflame, where hundreds of these plants cover the steep sides of Muiskraalkop. Ideal plant for a rockery. Another aloe which is widespread in the western and eastern southern karoo is *A. variegata* which is noted with the aloes of the dry central regions (see under 4.2).

A. pictifolia Hardy [colour p. 251]: Humansdorp district, Eastern Cape. The name 'pictifolia' means 'painted leaves', a reference to the extensively white-spotted surface of this narrow-leaved, cliff-hanging species which was discovered in 1971. Out of habitat, this plant is reminiscent of *A. micro-*

stigma, to which it is probably closely related. In its natural state, it is a small plant which branches into great clusters which overhang rocks, the curving leaves reflexed or ascending. The inflorescence is often horizontal, with an ascending raceme of scarlet flowers.

A. humilis (L.) Mill.: This tiny 'hedgehog' species which is softly spined has already been mentioned with the Eastern Cape aloes, the larger forms (usually in large clumps) exist in the Oudtshoorn, Calitzdorp and Willowmore districts. Like many of the dwarfed aloes, the flowers, in orange or scarlet, appear relatively big and the peduncle is well-covered with white bracts. It was discovered early and cultivated in the Dutch East India Company's garden at the Cape in 1695.

A. brevifolia Mill. [colour p. 251]: A coastal species extending from Bredasdorp to Riversdale in the western Cape. A neat, compact little aloe with rosettes up to 100 mm across, offshoots producing tight clusters of up to 10 plants. The leaves are glaucous with white marginal teeth. The inflorescence has a conical raceme of pale scarlet flowers; the peduncle has many thin white bracts. *A. brevifolia* var. *postgenita* from between Swellendam and Ashton has longer leaves than the typical variety, and var. *depressa* (near Caledon) is the largest form, with rosettes up to 300 mm in diameter.

A. glauca Mill. [colour p. 251]: South-western Cape and Namaqualand. This is a vigorous aloe, usually short-stemmed, but can be taller-stemmed as at Bonnievale. The leaves are unspotted and glaucous (400 mm long, 150 mm broad at the base), with a very characteristic inflorescence: the peduncle is thick and bract-covered, the broad raceme of red or pink flowers ending bluntly, the buds densely packed and completely covered by bracts with recurving tips. The Namaqualand form has spiny leaves and forms clusters with smaller rosettes. In the karoo the leaves are less fleshy than in the typical form near Swellendam. In the Piquetberg district var. *muricata* has leaves which are reddish and less glaucous. A very small form occurs near Nieuwoudtville. The heavy blunt raceme flowers from August to October.

The following three species have the problem of similarity in habit: *A. mitriformis*, an old species described in 1768 and the smaller, coastal *A. distans* (1812) both sprawl horizontally on the ground;

A. comptonii (described by Reynolds in 1950 in his work on aloes) is an eastern karoo aloe which is compact and erect.

A. comptonii Reynolds [colour p. 252]: Central southern Cape: Willowmore, Seven Weeks Poort, Uniondale, Steytleville. Reynolds named this species after Prof. R.H. Compton, who was then Director of Kirstenbosch Gardens. It is a handsome, almost erect species with rosettes up to 500 mm in height; the inflorescence is a 3-5 branched panicle bearing attractive heads of scarlet flowers from August to January. It differs from the closely allied *A. mitriformis* by never adopting a marked procumbent habit (see previous paragraph).

A. mitriformis Mill. [colour p. 252]: Present in kloof and poort in the south-western Cape; from north of the Cape Peninsula to Nieuwoudtville in the Bokkeveld mountains; it is spectacular in Cogmans Kloof between Ashton and Montagu. In this sprawling species, the stems lie along the ground, the apical leafy rosettes being slightly upturned; the fleshy leaves (200 mm long, 100-150 mm broad) have yellowish spines on the margins and on the slight distal keel; the inflorescence is 2-5 branched, erect, the racemes densely capitate with scarlet flowers in summer.

A. distans Haw [colour p. 252]: On limestone ridges along the coast near Saldanah in the south-western Cape. Like *A. mitriformis* this species is procumbent unless supported by its own dense growth; the leaves (150 mm long, 70 mm broad) may be sparingly spotted and have yellow marginal spines. The densely-flowered capitate racemes in orange-red appear in December. Apart from its smaller size it is very similar to *A. mitriformis*.

A. chlorantha Lavranos [colour p. 252]: In the southern region of the Northern Cape Province: dry northern slopes in the Sutherland and Fraserburg Karoo. The plants are stemless or have procumbent stems up to 1.5 m long, dividing to form clumps of up to 6 or more rosettes. The leaves are bright green to purplish, spotted on the lower surface and have brown marginal teeth. The name 'chlorantha' refers to the small, inconspicuous yellowish-green flowers (10 mm long) which are borne on a simple inflorescence up to 1.5 m tall. The small open flowers have erect pedicels of up to 20 mm which enable them to emerge from behind the large fleshy bracts; flowering October to November.

4.2 The dry central regions (including south-western and southern Free State), and Botswana

The dry central divisions of southern Africa do not have a great variety of aloes. In Botswana the following species have been recorded: *A. zebrina*, *A. littoralis*, *A. esculenta*, *A. marlothii*, *A. cryptopoda*, *A. greatheadii*, *A. grandidentata* and *A. globuligemma*. In the Northern Cape *A. striata* subsp. *karasbergensis*, *A. hereroensis*, *A. grandidentata*, *A. broomii* and *A. claviflora* are known to occur, sometimes, as in the case of *A. claviflora*, in vast numbers. In the central karoo the aloes are mainly represented by *A. variegata*, *A. claviflora*, *A. broomii*, *A. microstigma* and *A. longistyla*. In the Free State the following species occur: *A. hereroensis*, *A. broomii*, *A. claviflora*, *A. variegata*, *A. grandidentata*, *A. ecklonis*, *A. greatheadii* var. *davyana*, and the dwarf *A. aristata*. All of the above aloes, with the exception of the following several, are described in other sections, most of them have very wide distribution.

A. grandidentata Salm-Dyck: Northern Cape and North West Provinces, Botswana and western Free State. Stemless or short-stemmed, forming dense clusters by suckering; leaves spotted on both sides, margins horny with reddish spines 3-5 mm long and nearly 10 mm apart. This maculate aloe is distinguished from all other species in the series by its clavate perianth; in all other respects it is a very typical spotted-leaf aloe. The inflorescence has cylindric racemes of dull reddish flowers from August to September.

A. claviflora Burch. [colour p. 252]: This species is widespread from north of the Suurberg westwards to Prince Albert, northwards to both sides of the Orange River, extending from the Free State to Warmbad in Namibia. When travelling by car from Kimberley to Upington in August one passes through flowering fields of this aloe extending for 30 km or more. It dislikes being outside its arid habitat which makes cultivation difficult. In spring, the densely-flowered, almost horizontal red racemes with protruding yellow stamens appear from the decumbent glaucous rosettes which are arranged in an ever-widening circle. 'Kanonaalwyn' is an apt name as the racemes do resemble cannons pointed outwards from a laager (circular camp); it is also called 'kraalaalwyn' ('kraal meaning pen or enclosure).

A. broomii Schönk. [colour p. 252]: Central karoo from Prieska to Murraysburg; from Britstown eastwards through central Free State to southern Lesotho. The solitary plants, short-stemmed or procumbent to 1 m, prefer north-facing rocky slopes, in deep grass. The plant may form a huge rosette up to 1 m across of yellowish-green, faintly lineate leaves with sharply spinescent margins. From August onwards, these plants develop the striking, simple, candle-like inflorescence in which the buds and pale lemon flowers are covered by the whitish 30 mm long bracts. The species was first collected in 1905 by Dr Robert Broom, the anthropologist. The densely-leaved rosettes are reminiscent of *A. polyphylla* in Lesotho. Var. *tarkaensis* occurs south of Tarkastad in the Eastern Cape. It is more robust, with broader, brownish or reddish leaves, and the buds and flowers are visible, the bracts being much shorter, and it flowers in February. Lavranos has suggested a relationship between *A. broomii* and the yellow-flowered *A. chlorantha* of the south-western karoo.

A. variegata L. [colour p. 253]: Widespread in the central and southern parts of South Africa, including south-western Free State, Namaqualand and southern Namibia; the Little Karoo and from Laingsburg in the west to the Fish River in the Eastern Cape. The 'Kanniedood' (cannot die) or 'Partridge-breast aloe' is difficult to assign to a geographical division but is essentially a 'dry weather' aloe and does not take kindly to a wet climate. It is a distinctively coloured dwarf, having clean, dark green, white-spotted triangular leaves in three ranks, and several short-stemmed racemes of large scarlet or pink flowers. The seeds are large with broad wings and are wind-dispersed (this always accounts for wide distribution). Another dwarf which occurs in the dry central region is *A. longistyla* which has been described under the small aloes of the Eastern Cape (under 2.1).

4.3 Namaqualand and the north-western region of South Africa

A. krapohlana Marloth [colour p. 253]: From Vanrhynsdorp northwards to the Orange River, and westwards to Pella. A beautiful small aloe with narrow, glaucous, incurving leaves (200 mm) which are often banded transversely; developing 2-6 relatively large bright scarlet racemes (400 mm from the base). Var. *dumoulinii* is smaller than the typi-

cal plant and forms clusters of up to 15 heads; it occurs in northern Namaqualand. This species is best left in the veld as it seldom survives outside habitat where it has sparse winter rainfall of 125-250 mm. Flowers from June to August.

A. melanacantha Berger [colour p. 253]: Extends from Vanrhynsdorp through Namaqualand across the Orange River into southern Namibia. It was discovered at Springbok during Simon van der Stel's expedition in 1685. Easily recognised by its formidable black thorns, the plant has a ball-like rosette 250 mm in diameter, and usually occurs in clusters. The simple inflorescence (1 m) has a densely-flowered raceme of scarlet flowers which turn yellow. Flowers in June.

A. falcata Baker: From Vanrhynsdorp northwards to the Orange River and Bushmanland. The leaves (300 mm) are falcate (sickle-shaped), rough, greyish-green with toothed margins. Like its close allies, *A. asperifolia* and *A. claviflora*, this species is shortly procumbent, with the leaf rosettes tilted sideways, but is distinguished by its inflorescence which is 6-10 branched with erect, cylindric-acuminate (300 mm) racemes of dull red flowers which appear in December.

A. pearsonii Schönl. [colour p. 253]: In the Richtersveld south of the Orange River and northwards into Namibia to Witputs. A very distinctive tall, narrow species (1-2 m) which branches into large shrubs up to 2 m in diameter. The recurved leaves form four ranks along most of the stem, turning dull red and becoming deflexed during prolonged drought. The laterally produced inflorescence (400 mm) bears a raceme (150 mm) of yellow or brick-red flowers in summer. The species was named after the first Director of Kirstenbosch, Dr H.H.W. Pearson, who collected it in 1910.

A. arenicola Reynolds [colour p. 253]: Coastal sandveld from Lambert's Bay to the mouth of the Orange River. It is related to *A. mitriformis* and *A. distans*, but differs in having copiously spotted blue-green leaves (180 mm) whereas the other two species are greyish-green. It is erect to procumbent, depending on its site, forming dense clusters; the racemes are capitate with pinkish-red flowers, the perianth often 40 mm long. The species survives in very arid conditions in which the chief source of moisture is mist from the Atlantic. Flowers from July to January, probably in response to rain.

A. comosa Marloth & Berger: Between Clanwilliam and Vanrhynsdorp in the Doring and Olifants River valleys. This is one of the few tall aloes in the western region, solitary, up to 2 m high, with old leaves persistent. A single plant may have 3-8 strikingly tall slender inflorescences (2.5 m) in bi-coloured pink and cream, presenting an overall height of 4.5 m. A distinctive feature is the manner in which the pendulous open flowers are pressed against the peduncle. A statuesque species which flowers in summer.

A. gariepensis Pillans [colour p. 253]: On both sides of the Orange River from near its mouth eastwards to Keimoes; plentiful at Warmbad and elsewhere in southern Namibia. A handsome short-stemmed or stemless species with lineate leaves (400 mm) incurved, yellowish-green or reddish-brown in arid areas. Two to three inflorescences (1.2 m) appear from a single plant, the raceme long and pointed, varying in colour from all yellow at Port Nolloth and on the sides of the Fish River canyon to reddish and bicoloured in yellow and orange at Keimoes. It flowers in September, or earlier.

A. framesii L. Bolus: Coastal sandveld from Saldanha Bay to the Orange River mouth. Short-stemmed or procumbent, forming large groups on sandy flat country, and never adopting the tall, erect habit of the closely related *A. khamiesensis* which grows further inland. The leaf rosettes are up to 500 mm across, the leaves spotted or immaculate; the inflorescence (700 mm) is usually 2-3 branched, conical-pointed racemes of dull scarlet flowers appearing in June.

A. khamiesensis Pillans [colour p. 253]: Along the Khamiesberg from Garies to Springbok, and in the Bokkeveld Mountains further south. Growing in mountainous country, this species is closely allied to *A. framesii* which keeps to the coastal region. It differs from the smaller species only by being larger with an erect habit and overall height of up to 2.5 m. The stem is simple or branched and covered with persistent old leaves. The branched panicle produces 5-8 long conical racemes of orange-red flowers in the winter.

A. striata Haw. [colour p. 246]: Subsp. *striata* occurs in the Eastern and Western Cape. Subsp. *komaggasensis* is endemic to Namaqualand, where it has a limited distribution west of Springbok at Komaggas. The leaves are faintly striated, the leaf

margins denticulate, white to yellow. These characters and the yellow flowers separate it from the other subspecies. It is summer-flowering, from December to January. Subsp. *karasbergensis* (*A. karasbergensis*) is the northern form of this species with a wide distribution in the Northern Cape (Richtersveld and south of the Orange River to Prieska) and southern Namibia. On sand flats this form clusters, in the mountains it is usually solitary. The leaves are conspicuously green-veined, the margins white, entire, and sometimes crenulate. The inflorescence is a much-branched pyramidal panicle which is laxly flowered, the flowers pink to red, flowering from January to March.

A. buhrii Lavranos [colour p. 254]: Calvinia district in the western karoo (Northern Province); restricted to hilltops where it receives a winter rainfall of 150–200 mm. Its affinities lie with the *Paniculatae*, *A. striata* and *A. reynoldsii*, neither of which occur near its vicinity. It resembles the *A. striata* group by having smooth striated leaves with a broad red margin and a much-branched inflorescence of orange-red flowers in which the perianth has a basal swelling 6 mm in diameter. It differs chiefly in having clusters of upright rosettes of narrow curved leaves 400 mm long, 90 mm broad at the base, the leaf border being denticulate or almost entire. Flowering August–October.

A. meyeri Van Jaarsveld: A cliff-dwelling species on southern rock faces of the Rosyntjieberg Mountain Range in the north-eastern Richtersveld; it just enters Namibia where it inhabits the mountain tops on the northern side of the Orange River. It is closely related to *A. mitriformis* but is much smaller. With stems up to 1 m long it hangs downwards; leaves glaucous, margins denticulate. The simple inflorescence is 150–250 mm long, pendulous-recurved, with capitate raceme of orange-red flowers. Flowering from December–February.

A. dabenorisana Van Jaarsveld: The Dabenoris Mountain is a small range 7 km south of the Orange River in Bushmanland in the Northern Cape. This species is another cliff-dweller. It was described by Van Jaarsveld (*J. S.A. Bot.* 3, 1982) after its discovery by A.R. Mitchell in 1980. The species is similar to *A. meyeri*, and therefore has affinities with the series *Mitriformes*, but is distinguished by its larger size (rosettes 450 mm across), the channelled, severely recurved leaves and the branched peduncle. The inflorescence is pendulous-recurved

with reddish flowers. Since then the species has been found on the Pella Mountains. Van Jaarsveld suggests an affinity with *A. pearsonii*, because of the severe recurving of the leaves, and, in the young plants, the leaves are in vertical rows, with the same colour as in *A. pearsonii*.

The following three western species all belong to the section *Dracoaloe*. These include large shrubs to tall trees, dichotomously branched. All have fleshy yellow flowers.

A. ramosissima Pillans [colour p. 254]: Mountainous parts of the Richtersveld and southern Namibia. The only shrub of the trio, it branches dichotomously from ground level to an average height of just under 2 m. The clean greyish stems have an apical rosette of linear leaves up to 200 mm long; the terminal canary-yellow racemes of flowers are exactly like those of *A. dichotoma*. In some areas a gradual transition from *A. dichotoma* into *A. ramosissima* has been observed but typically the latter is a shrub, not a tree.

A. dichotoma Masson [colour p. 254]: In Namaqualand as far south as Garies, on both sides of the Orange River and westwards to Postmasburg in the Northern Cape; southern Namibia especially along the Fish River, and north to Usakos. This is the famous 'kokerboom' recorded by Simon van der Stel in 1685 and referred to as '*Aloe arborescens*'. It is one of the three tree aloes which occur in southern Africa, having a simple stem which branches and rebranches dichotomously from the middle of its height of 6–9 m. It is often the only tree for great distances and is, with the telephone poles, a great boon to the social weaver birds, who build their 'haystack' nests in its branches. Closely related to the shrubby *A. ramosissima* and to the other western tree species, *A. pillansii*, it can be distinguished from the latter by its erect terminal inflorescence of yellow flowers; in *A. pillansii* the inflorescence is lateral and curves downwards among the lower leaves of the rosette. *A. dichotoma* keeps to the crest of the hills and their slopes and is seldom seen in the valleys. It flowers in winter.

A. pillansii L.Guthrie [colour p. 254]: Best known on Cornell's Kop east of Grootderm in the Richtersveld and northwards into the Namib desert of Namibia. A stately tree aloe reaching 10 or more metres in height, usually with less and more erect branches than *A. dichotoma*, its leaves (500–600

mm) being much larger than in the latter. It is easily distinguished by its inflorescence which is produced laterally and hangs downwards among the lowest leaves, the racemes of yellow flowers turning upwards; flowering from September-October.

4.4 Namibia

There are 26 *Aloe* species in Namibia (Patricia Craven, NBRI, Namibia 1998); 12 of these are described below, the rest are referenced: *A. littoralis* in Tall Eastern aloes (under 1); *A. microstigma* in Southern and south-western Cape (under 4.1); *A. claviflora* and *A. variegata* in the dry central regions (under 4.2); *A. dichotoma*, *A. gariepensis*, *A. meyeri*, *A. melanocantha*, *A. pearsonii*, *A. pillansii* and *A. ramosissima* in Namaqualand and the north-western region of South Africa (under 4.3); *A. buettneri* and *A. esculenta* in Angola (under 4.5); *A. zebrina* in Transvaal Provinces (under 2.3).

A. erinacea Hardy: Lüderitz district and southwards to Witputs. This aloe is related to *A. melanocantha* but can be distinguished from the latter by its open rosettes of spreading leaves and shorter flowers. The densely-leaved compact plants occur in clusters of ten or more, with decumbent stems up to 500 mm covered with old leaf bases. The pale greyish-green leaves are convex on their upper surface and well-armed with sharp black spines which are white on the younger leaves. The simple inflorescence (1 m) is densely-flowered in red, turning yellow, appearing in winter.

The widespread *A. variegata* is fairly common in the south and has two much rarer relatives, all three

possessing spotted leaves which are keeled; the stubby, thick peduncle of *A. variegata* is very distinct from the tall, elegant inflorescences of the two desert species entered below:

A. dinteri Berger: In the Namib desert it occurs on the Spitskoppe, on limestone ridges in the Kaokoveld and north-west of Tsumeb. It is easily distinguished from its close relatives by its taller habit, the rosettes of leaves being 260 mm high; the brown leaves are V-shaped in cross-section and heavily spotted on both surfaces. The inflorescence (500-800 mm) has 3-8 branches of pale pink flowers which appear from January to March.

A. sladeniana Pole Evans: Western escarpment: Zaris and Naukluft Mountains. The smallest of the three, *A. sladeniana* in its natural state is seldom more than 50 mm high and suckers to make clusters. The triangular leaves are 30-40 mm broad at the base, narrowing abruptly to the distal point, margins thinly white and denticulate. The inflorescence is simple or sparingly branched, laxly-flowered in dull pink; flowering January to February.

A. striata Haw.: Subsp. *karasbergensis* (Pillans) Glen & Hardy (*Aloe karasbergensis*): Extends from Prieska in the Northern Cape west to the Richtersveld and northwards into southern Namibia. Stemless or with stems up to 300 mm in decumbent plants; on sand flats the plants may form dense clusters or are solitary in rocky terrain. It is similar to the typical subspecies but differs in having more markedly lineate leaves; the leaves varying in colour from glaucous green with dark green lines to mauve with deep reddish lines. The inflorescence tends to be shorter; the many-branched panicle tends to form a pyramid, the racemes laxly-flowered, whereas in subsp. *striata* the racemes, more dense-flowered, tend towards a flattened panicle. The typical subspecies flowers in the spring (August to October) whereas the two northern subspecies *komaggasensis* and *karasbergensis* are summer flowering (December-February).

A. asperifolia Berger [colour p. 255]: Central and northern Namibia and southern Kaokoveld. This species forms circular groups of up to 40 plants. The name, 'asperifolia' refers to the roughness of the greyish-white leaves. It is similar in habit to *A. claviflora*, but differs in that its oblique inflorescence is slender, laxly-flowered and not nearly as



Aloe erinacea, Namibia

attractive. Its pinkish-red flowers have upturned mouths, while those of *A. claviflora* are club-shaped. It flowers from March to May.

A. pachygaster Dinter: West of the Fish River in the Lüderitz and Bethanie districts. Another circle-forming species with short, procumbent stems and rough narrow leaves armed with dark teeth on margins and in a median line on the outer leaf surface. The buds are covered by large bracts and the simple oblique inflorescence differs from *A. asperifolia* in being densely-flowered in coral-red (flowering July-August). This aloe is similar to *A. claviflora* but is distinct from the latter because of its longer bracts (20-25 mm compared to 15 mm in *A. claviflora*) and narrower leaves (width at base 20-25 mm compared to 60-80 mm in *A. claviflora*).

A. argenticauda Merxm. & Giess: Bethanie, Mal-tahöhe and Rehoboth districts. The name 'silver tail' refers to the elongated, bract-covered upper part of the inflorescence which is up to 1.2 m tall. Reynolds referred (with some doubt and discussion) to this species as *A. pachygaster*, and suggested that further investigation was required. It is distinct from Dinter's *A. pachygaster* in several features: *A. argenticauda* is a larger plant, has an erect inflorescence and the conspicuous bracts are very long (50-70 mm compared to 20-25 mm in *A. pachygaster*).

A. namibensis Giess [colour p. 255]: Central Namib and eastwards to Karibib. The handsome rosette (650 mm across) is grey-leaved, stemless or decumbent up to a metre; the stem may root along its length. The leaves are rough, up to 500 mm long with deltoid spines on the margins. The erect inflorescence (1 m) divides into 3-6 upright racemes of coral-red flowers with long bracts (35 mm). It flowers in late summer, the inflorescence remains attractive for some time as the perianth does not dry out but remains fleshy after pollination.

A. dewinteri Giess: Occurs on steep precipices in the Kaokoveld. Stemless, solitary plants, wedged into rock crevices; the grey leaves have a brown-toothed margin and are deeply canaliculate. The inflorescence (700 mm) is bicoloured: The flowers are pale red turning yellowish when open, the buds are bract-covered. Flowering from October-November.

A. corallina Verdoorn [colour p. 255]: Present on

cliff faces on the slopes of the Baynes Mountains in the northern Kaokoveld. A stout stem, naked and pendulous in older plants, subtends the light greyish-green, hard leaves which are densely rosulate, about 0.5 m long, flat in the lower half but channelled towards the leaf-tip. Inflorescence branches in its upper part into 2 or 3 peduncles, arcuate-ascending, the racemes erect, up to 280 mm, the perianth subclavate, coral red, about 30 mm long. In *A. dewinteri* which occupies similar habitat in the Kaokoveld the inflorescence branches in its lower half and it flowers from October, whereas *A. corallina* (in cultivation in Pretoria) flowers in May.

A. viridiflora Reynolds [colour p. 255]: Khomas Highland west of Windhoek. Discovered by W. Triebner in 1932, who found plants with rosettes almost 1 m in diameter. This stemless, solitary aloe has grey leaves with brown marginal teeth; at first glance the plant resembles *A. hereroensis* generally, and especially in the graceful arcuate branches from the central peduncle. The flowers are distinct and unusual: The perianth clavate in shape and green in colour, the orange stamens exerted for 10 mm. Flowering in September.

A. hereroensis Engler [colour p. 255]: Widely distributed from the Free State and Northern Cape in South Africa, extensive in Namibia and into southern Angola. This hardy and attractive species will survive in high summer rainfall areas if given good drainage; according to Reynolds (1966) the species prefers lime in the soil. The grey leaves are up to 300 mm long, about 60 mm broad, faintly striated and become rose-coloured in the sun. The inflorescence (1 m) divides at the middle into 4-8 arcuate-erect branches; the yellow, orange, scarlet or red flowers are in densely capitate heads which terminate in a dense hairy tuft of over-lapping bracts. The yellow-flowered form is known as var. *lutea* and occurs in Namibia. The erect nature of the buds and spreading-pendulous habit of the open flowers is very marked in this species. It flowers June-September.

4.5 Angola

A. buettneri Berger: Widely distributed from northern Malawi westwards to the watershed in Angola, southwards to the Zambian copperbelt and northwards to Mali: a range of more than 5600 km. A robust form occurs in northern Namibia. *A. buett-*

neri is a stemless, solitary plant with green, leathery, canaliculate and marginally dentate leaves (450 mm) which die back during the dry season; the leaf bases swell forming a bulb of up to 100 mm in diameter. The racemes vary from sub-capitate to conical, and from yellow to red; the base of the perianth is always inflated. Depending on locality, the species flowers between January and July. The bulbs of this species, *A. richardsiae* and *A. bullockii* of Tanzania, as well as *A. kniphofioides* and *A. inconspicua* of South Africa, all serve as a reminder that the aloe is not very far removed from the popular concept of a lily.

A. grata Reynolds: South of Chinguar in the Nova Lisboa district on the Bie plateau. A stemless species with smooth, greyish-green leaves spotted on the lower surface near the base, forming clusters along cracks in rocky places, rather like *A. chabaudii* in the same series (*Aethiopicae*); the inflorescence (900 mm) has capitate racemes of scarlet flowers, but the axial system is very different, the inflorescence being simple, or forked, or with three branches in older plants; on the other hand the perianth is very similar to that of *A. chabaudii* especially with regard to the inverted cone shape at the base where it tapers toward its union with the pedicel. The sparsely-branched inflorescence matches up well with that of *A. mzimbana* which has a central and eastern distribution, and is abundant in Zambia. It flowers in June.

A. milne-redheadii Christian: Discovered in the Moxico district of Angola, it also occurs in the north-western province of Zambia. Another species in the attractive series *Aethiopicae*, this plant is stemless, clump-forming with brownish-green spotted leaves. The inflorescence (500-800 mm) branches into cylindric-acuminate racemes of scarlet flowers; the perianth (35 mm) is inflated at the ovary region but flattens at its union with the pedicel. Flowers from June-July.

A. metallica Engler & Gilg.: Cuchi River gorge in the Bie district of Angola. Single, stemless plants with leaves up to 400 mm long making a compact rosette. The leaves have reddish-brown pungent marginal teeth, otherwise smooth and dull bluish-green with no markings. The inflorescence (1.2 m) is simple or two-branched, the raceme tapering to a very long narrow point and bearing reddish-pink flowers subtended by long white bracts which cover the buds. Flowers between April and July.

A. mendesii Reynolds [colour p. 255]: On western escarpment of Humpata plateau at Bimbe in the Huila district of Angola; mountains south of the Cunene River in northern Namibia. The species is pendent, adapted, like the closely related *A. veseyi* of Kalambo Falls in Zambia, to existing on precipice faces in mountainous areas. The whole plant, except the raceme, is pendent; the leaves (500 mm) are fairly narrow and taper to a long point. Unlike the lax, yellow-flowered *A. veseyi*, it has an ascending, cylindric, pointed raceme densely-flowered in scarlet, with longer, deep pink bracts (12 mm); in *A. veseyi* the flowers have white bracts 6 mm long. *A. mendesii* flowers between April and July.

A. inamara Leach: On vertical cliffs at the mouth of the Quicombo River, 10 km south of Novo Redondo, Angola. This species which was discovered by Leach and Cannell and described by Leach in 1971 bears a remarkably close resemblance to *A. veseyi* of Zambia, and was separated on the main grounds that the base of the perianth tube is inflated, the flowers are red, and the sap does not have the bitter taste of *A. veseyi*, which has pale yellow flowers.

A. guerrai Reynolds: Fairly widespread in central Angola from Luanda Province south to Benguela and west to General Machado. Its placement in the subsection *Ortholophae* (amended) is immediately recognised, because of the tall, branched inflorescence bearing secund flowers. A solitary, almost stemless species with about 24 narrow, long-pointed, dull green leaves (400 mm) with reddish-brown marginal teeth and no spots. The tall inflorescence (1 m) is a branched panicle which has oblique laxly-flowered racemes of scarlet, secund flowers. Its habit is somewhat similar to that of *A. secundiflora* of Tanzania. *A. guerrai* flowers from June to July.

A. procera Leach: Cuanza Sul district, about 50 km north of Quibala. Discovered by Leach and Cannell, this Angolan species is solitary, small, stemless or with a short stem (250 mm), the rosette consisting of about 20 pale green, thin, unspotted leaves up to 550 mm in length. The remarkable feature is the very tall paniculate inflorescence which is up to 2.75 m in height! The buds and flowers are secund, lax and bend backwards, dull reddish-purple in colour, the anthers orange-brown. The tall inflorescence is undoubtedly an adaptation to its habitat, since the species grows among tall grasses.

A. rupicola Reynolds: Bie district; on hills south of Chinguar. One of the few tall species in Angola, it is 2-3 m in height; Reynolds places it with the other tall-stemmed aloes such as *A. excelsa* and *A. littoralis*. The leaves are unspotted, up to 350 mm long with dentate margins, deciduous, leaving a grey, bare stem 120 mm thick. This tall grey stem recalls the habit of the Zimbabwean eastern mountainous species, *A. munchii*. The inflorescence (900 mm) is a branched panicle bearing orange-scarlet flowers in cylindric racemes, flowering in June.

A. esculenta Leach: Angola, Zambia, Namibia, Botswana. Closely related to *A. littoralis* (which occurs widely in Angola), this species was described by Leach in 1971; it refers to the great masses of plants which occur on the sandy flat soils to the south and east of the Cunene River, and which reach maximum size in Odangua in Ovamboland, Namibia. The species is stemless, gregarious, often forming clumps, and its leaves are copiously white-spotted. The inflorescence usually has 3-6 racemes, whereas *A. littoralis* has up to 20 closely set racemes of scarlet flowers. Reynolds was certainly aware of this species, but decided they were "young acaulescent (stemless) plants" (of *A. littoralis*), and "young plants have leaves copiously spotted", obviously

A. littoralis cohabited otherwise Reynolds would have realised these plants did not develop tall stems!

A. lepida Leach: On rocky slopes 27 km south-east of Nova Lisboa. About 300 mm in height, it branches at the base into erect stems; the spotted recurved leaves are yellowish-green and have large marginal teeth. The decorative inflorescence (500 mm) is 1- to 2-branched, with cylindric-tapering racemes of orange-scarlet flowers which are faintly yellowish-striped. It is very close to *A. andongensis*, but differs in having wider, strongly recurved leaves (90 mm at base, 200-280 mm long) and the erect laxly-flowered racemes are 200 mm long.

A. scorpioides Leach: Moçâmedes district. A low, branching, spreading shrub up to 500 mm high, with yellowish-green leaves, unspotted, with yellowish marginal teeth. The slender peduncle often descends and then curves upwards, bearing a narrow, erect raceme (150 mm) of scarlet, yellow-striped flowers. It is apparently closely related to *A. palmiformis*.

A. palmiformis Baker: Huila district. A slender plant branching from the base to a height of 1-1.5 m, bearing its narrow recurved leaves near the top



Aloe gossweileri, Angola



Aloe marlothii (p. 214)



Aloe rupestris (p. 215)



Aloe arborescens, Heidelberg, Cape (p. 216)



Aloe excelsa, colour range at Ewanrigg, Zimbabwe (p. 215)



Aloe marlothii (p. 214)



Aloe arborescens, Inyanga, Zimbabwe (p. 216)



Aloe pluridens (p. 216)

*Aloe lineata* (p. 216)*Aloe africana* (p. 216)*Aloe ferox*, unusual white form
(p. 216)*Aloe speciosa* (p. 217)*Aloe littoralis*, Namibia (p. 217)*Aloe mawii* (p. 217)*Aloe striata* subsp. *karasbergensis* (p. 217)*Aloe striata* subsp. *striata* (p. 217)



Aloe reynoldsii (p. 218)



Aloe ciliaris (p. 218)



Aloe ciliaris with *Crassula multicaeva* (p. 218)



Aloe howiea (p. 219)



Aloe longistyla (p. 219)



Aloe pratensis (p. 219)

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Aloe aculeata, Matopos, Zimbabwe (p. 225)



Aloe tauri, Mount Igat, Zimbabwe (p. 226)



Aloe chabaudii var. *chabaudii* (p. 226)



Aloe ortholopha (p. 226)



Aloe kniphoioides (p. 229)



Aloe ballii (p. 233)



Aloe myriacantha, Grahamstown (p. 228)

*Aloe ecklonis* (p. 232)*Aloe dominella* (p. 230)*Aloe howmanii* (p. 233)*Aloe musapana* (p. 233)*Aloe cannellii* (p. 235)*Aloe inyangensis* (p. 234)*Aloe hazelliana* (p. 234)



Aloe microstigma (p. 236)



Aloe haemanthifolia (p. 236)



Aloe plicatilis (p. 236)



Aloe glauca (p. 237)



Aloe pictifolia (p. 236)



Aloe brevifolia (p. 237)



Aloe nuttli, Malawi (p. 235)

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Aloe variegata (p. 238)



Aloe arenicola (p. 239)



Aloe khamiesensis (p. 239)



Aloe krapohlana var. *dumoulinii* (p. 238)



Aloe pearsonii (p. 239)



Aloe gariensis (p. 239)



Aloe melanacantha (p. 239)

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Haworthia mirabilis var. *paradoxa* (p. 272)



Haworthia mirabilis var. *badia* (p. 272)



Haworthia retusa (p. 272)



Haworthia emelyae (p. 272)



Haworthia springbokvlakensis (p. 272)



Haworthia truncata var. *truncata* (p. 273)



Haworthia arachnoidea var. *aranea* (p. 273)



Haworthia arachnoidea var. *setata* (p. 273)



Haworthia arachnoidea var. *scabrispina* (p. 273)



Haworthia lockwoodii (p. 274)



Haworthia mucronata var. *morrisiae* (p. 274)



Haworthia nortieri var. *pehlemannia*
(p. 274)



Haworthia cooperi var. *leightonii* (p. 274)



Haworthia cooperi var. *pilifera* (p. 274)



Haworthia cymbiformis (p. 275)



Haworthia gracilis var. *tenera* (p. 275)



Haworthia variegata with *Gasteria carinata*, south-western
Cape (p. 275)



Haworthia variegata (p. 275)



Haworthia outeniquensis, at Herold (p. 275)



Haworthia blackburniae (p. 276)



Haworthia scabra var. *starkiana* (p. 276)



Haworthia longiana (p. 277)



Haworthia reinwardtii (p. 278)



Haworthia scabra var. *morrisiae* (p. 276)



Haworthia viscosa (p. 279)



Haworthia pumila, Worcester (p. 280)



Haworthia venosa subsp. *venosa*,
Bontebok Park (p. 279)



Haworthia marginata (p. 280)



Haworthia kingiana (p. 280)

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Aloaceae

Five minor genera

This chapter covers five genera which are leafy and mainly small in size. Only in *Gasteria* are there several larger species – the tallest being *G. acinacifolia* (up to 750 mm in height), the most massive being *G. excelsa* (up to 600 mm) and *G. croucheri* (400 mm). *Astroloba* which is clump-forming may reach a good height (about 500 mm) whereas the similar genus, *Haworthia*, is usually small to dwarf, the unsuitably named *H. pumila* (60–300 mm) being the largest species. The leafy stems of the monotypic *Poellnitzia* may reach 250 mm. Also monotypic is *Chortolirion*, stemless and small. One of several interesting features is that all are endemic to South Africa (and Swaziland) except *Gasteria pillansii* var. *ernesti-ruschii* which has ventured beyond the Orange River into southern Namibia.

Only *Gasteria* and *Poellnitzia* have colourful flowers (as in *Aloe*) but these are different morphologically. The swollen ‘belly’ of the *Gasteria* flower is not akin to the swollen perianth base of the maculate *Aloe*.

Gasteria Duval

Gasterias were initially classified by Linnaeus as aloes. While both genera possess a somewhat similar succulent leaf habit and tall inflorescence of reddish-toned flowers, closer examination reveals distinct differences: aloe flowers have erect to spreading pedicels, whereas gasteria flowers have drooping pedicels, and the lower perianth is inflated (‘gaster’ from Greek, means ‘belly’). The strap-shaped or triangular leaves of *Gasteria* are very firm, with translucent skin, usually dark green with bands of whitish spots, the margins often horny but never spiny as in many aloes; sections of the leaf root easily and show a degree of vegetative

regeneration which is not present in the leaves of *Aloe*.

In 1827 Haworth published an account of 42 species under the name *Gasteria* (a name suggested earlier by Duval); his descriptions were based on material collected by James Bowie before 1826. This was followed by the illustration of 32 species of *Gasteria* in Salm-Dyck’s monograph of *The Aloes and Mesembryanthema*. In 1880 in his study of the tribe Aloineae (one of the 28 tribes of Liliaceae) Baker recognised 45 species of *Gasteria*. The genus was revised in 1908 by Berger, and later, from 1929, von Poellnitz described a further 24 species. Seventy-five *Gasteria* species were recognised by Jacobsen (Lexicon 1974).

In 1992 Ernst van Jaarsveld published a revision of *Gasteria* in *Aloe*, 29(1), in which he recognised 16 species (a total of 22 taxa). His field work resulted in a most interesting distribution map which clearly shows the almost total South African endemism of the genus; in present knowledge, only *G. pillansii* extends a short distance over the Orange River into Namibia, and *G. batesiana* extends in places into Swaziland.

All species of *Gasteria* (as in *Aloe*) have distichous leaves when young. Some species, like *G. pillansii* of Namaqualand, retain this habit throughout life, while others spiral into a rosette. The leaf shape, surface and margin may change during the life time of the plant, and these changes may not be constant throughout a population. This variability makes *Gasteria* taxonomy problematical.

In the 1992 revision van Jaarsveld assigns the species to two sections, which are again divided into two series each. The sections are delimited chiefly by the nature of the leaf and the perianth while the series depend solely on the nature of the perianth.

1 Section **Longiflorae** Haw.

Leaves smooth or rough, triangular and tapering to a point; perianth not markedly inflated at the base.

1.1 Series **Longiflorae** (Haw.) Van Jaarsveld

The perianth is 25-50 mm long (3 species).

G. batesiana Rowl. [colour p. 256]: (*G. transvaalensis*, *G. carinata* auctt. Rowl., *G. subverrucosa* var. *marginata*): Occurs well to the north of the main distribution area, extending from northern KwaZulu-Natal to the north-eastern Transvaal. It is a small attractive species (30-100 mm tall) with a rosette of triangular, dark green, spreading or recurved, keeled leaves which have bands of white spots, the surface densely tuberculate. The plant suckers to form clusters in rocky terrain with southern or eastern aspect. The simple inflorescence of large flowers appears from October to December.

G. croucheri (Hook.f.) Baker (*G. disticha* var. *natalensis*): Occurs from northern Eastern Cape to Mkuze river in KwaZulu-Natal, from the coast to about 30 km inland, keeping to the river valleys. This is a large species up to 400 mm in height, solitary in their southern distribution and forming dense groups in the north. The leaves are rosulate, triangular, erect and spreading, dark green or glau-

cous, surface smooth with white spots, the lower surface having an excentric keel. The inflorescence is branched and bears large flowers, perianth 28-40 mm long. Flowering occurs from November to February.

G. acinacifolia (Jacq.) Haw. (*G. nitens*, *G. acinacifolia* var. *nitens*, *G. candicans*, *G. ensifolia*, *G. acinacifolia* var. *ensifolia*, *G. pluripunctata*, *G. acinacifolia* var. *pluripunctata*, *G. venusta*, *G. acinacifolia* var. *venusta*, *G. inexpectata*): A coastal species from Knysna to Port Alfred in the Eastern Cape, inhabiting the dune thickets. This is the tallest gasteria species; the leaves, linear and well flecked with white, are up to 1 m in height (or length, in decumbent specimens). The leaves are rosulate, with smooth surface, rough margins and an abaxial, excentric keel. The inflorescence is branched to 1 m or more in dense scrub, and carries large pink flowers (perianth 35-50 mm long), flowering from September to December.

1.2 Series **Multifariae** (Haw.) Van Jaarsveld

Perianth shorter: 18-33 mm (7 species).

G. excelsa Bak. (*G. fuscopunctata*, *G. huttoniae*, *G. lutzii*): Covers a wide range of habitats in the Eastern Cape from Port Alfred to Kentani. Solitary, rosulate, this species is the second tallest gasteria and the triangular erect leaves reach up to 600 mm in height. Both leaf surfaces are smooth, obscurely spotted, margins sharp and rough, lower surface distinctly keeled. The inflorescence is branched and large, several per plant, over 1 m tall and 2.4 m in diameter, carrying light pink flowers (perianth 22-26 mm). Flowering from November to February.

G. pulchra (Ait.) Haw. (*G. poellnitziana*): Baviaanskloof and south-east to Hankey in the Eastern Cape. The plant is rosulate, solitary or in groups, and of medium size (200-360 mm tall). The narrow, tapering, white-spotted leaves are erect or nearly so, smooth surfaced, with rough margin and indistinct keel. The inflorescence branches up to 1.5 m and bears flowers (perianth 18-25 mm) from July to November.

G. nitida (Salm-Dyck) Haw. (*G. obtusa*, *G. decipiens*, *G. beckeri*, *G. nitida* var. *grandipunctata*, *G. nitida* var. *parvipunctata*, *G. stayneri*): Eastern



Gasteria acinacifolia



Gasteria nitida var. *nitida*



Gasteria nitida var. *armstrongii*

Cape, from Uniondale to Great Fish River mouth. A small gasteria, the sharply pointed, triangular, spiralled leaves are below 200 mm in height. In Trappes Valley (near Bathurst) the plant occurs in the open, at least half of the plant below soil level; in this area the species is endangered by removal of the whole plant by Xhosa Herdsman for the preparation of medicine. The inflorescence is a tall branched panicle of bright reddish-pink flowers (perianth 20-25 mm); flowering December to February. In the Van Jaarsveld revision the well known

G. armstrongii becomes *G. nitida* var. *armstrongii*. The distribution of this variety is limited to rocky flat terrain near the southern part of the Gamtoos River in the Eastern Cape. It is a dwarf distichous plant in which the dark green, densely tuberculated leaves are closely pressed into the soil, the leaf-ends obtuse, the leaf-pair rarely more than 60 mm in overall length in the wild. The leaf has a deep V-shaped proximal depression. It flowers from December to February. It was reduced to varietal status on the grounds of the distichous plants grading into the rosulate species. As the Gamtoos River population effectively blocks progression to the rosulate state, and as many of the Aloaceae have convergent zones, there is a strong case for maintaining *G. armstrongii* at species level.

G. ellaphieae Van Jaarsveld: On rock faces and slopes in the vicinity of Kouga Dam, south Eastern Cape. A miniature rosulate species from 15-40 mm tall. Solitary or in small clusters; the leaves are shortly triangular with lower excentric keel, dark green, surface densely tuberculate and margins rough. Inflorescence large for so small a plant, simple or branched up to 400 mm, flowers reddish-pink, perianth 22-27 mm. Flowers January to February.

G. glauca Van Jaarsveld: On cliff faces in the upper Kouga River valley in the Eastern Cape. Decumbent to erect, the plants are 50-70 mm tall, forming dense clusters up to 300 mm across. Leaves become rosulate, 50-70 × 15-18 mm, loratelanceolate and falcate, lower surface with an excentric keel, surface tuberculate and rough, glaucous, margin denticulate, apex acute with mucro. Inflorescence a simple raceme 120-250 mm with up to 20 reddish-pink flowers, perianth 30-34 mm long, stipitate, the inflated base 10 mm across, perianth ends erect and spreading, obtuse. Flowering December to January. This species was described after the 1992 revision. According to Van Jaarsveld (*Cact. & Succ. J. (US)* 70(2), 1998) the plants are related to *G. ellaphieae* which occurs in the same river valley, and distinguishes his new species from *G. ellaphieae* by its clustering nature, glaucous leaves, short unbranched racemes and larger flowers. *G. ellaphieae* is solitary or in small clusters, green, with smaller flowers. Both species are summer-flowering.

G. vlokii van Jaarsveld: Waboomsberg (Swartberg, north of Oudtshoorn) and Witberg (north-east of Willowmore). The only gasteria on mountain ter-

rain in fynbos vegetation, also found on lower slopes. A small rosulate species with leaves strap-shaped to triangular, falcate, white-spotted, asperulous, margins crenulate. Inflorescence simple up to 480 mm, perianth 29–33 mm long, flowering January to February. Distinguished from *G. carinata* by its spreading falcate leaves and larger flowers.

G. carinata (Mill.) Duv. [colour p. 256]: Southern Cape south of Riviersonderend and Langeberg mountains. A variable species; small to medium sized (up to 180 mm tall) rosulate or distichous, leaves triangular to triangular-lanceolate, usually tuberculate; forming dense groups. Inflorescence usually simple, perianth 16–27 mm long, flowering July to November. Several varieties are recognised: *G. carinata* var. *carinata* (*G. angulata*, *G. excavata*, *G. laetepunctata*, *G. subcarinata*, *G. sulcata*, *G. strigata*, *G. pallescens*, *G. porphyrophylla*, *G. parvifolia*, *G. humilis*, *G. schweickerdtiana*, *G. patentissima*): The typical variety has keeled leaves, a feature absent in the other varieties. Distribution as given above, from Hermanus to Mossel Bay. The spiralled leaves are usually covered with white, often domed, tubercles. It grades into the other varieties: the type material of var. *retusa* was collected from near De Wet at the western end of the Langeberg. It is found on mountain slopes on the northern side of the Breede River valley and Heidelberg district. The leaves are distichous, bluntly rounded at the apex, unkeeled, with white domed tubercles. It occurs with the similar *G. disticha*, apparently only its tuberculate nature and smooth leaf surface delimiting it from the latter species. Var. *verrucosa* (*G. intermedia*, *G. repens*, *G. verrucosa*, *G. subverrucosa*, *G. radulosa*): East of Bredasdorp at De Hoop and the Breede River mouth. Characterised by distichous tuberculate leaves, the leaf apex obtuse or acute. Variability includes a very large form (leaves up to 280 mm long) at Infanta (Breede River mouth) and a form with linear, channelled leaves at Herbertsdale. Van Jaarsveld refers to this complex as the most variable species in the genus. In 1998 he reinstated varieties *glabra* and *thunbergii* under this species (*Cact. & Succ. J (US)* 10(2), 1998).

2 Section *Gasteria* Duv.

Lorate (strap-shaped) leaves, surface asperulous (rough) to smooth, perianth markedly globose or narrow-elliptic.

2.1 Series *Namaquana* Van Jaarsveld

Perianth 25–45 mm long, indistinctly globose at the base (1 species).

G. pillansii Kensit [colour p. 256]: The only gasteria present in Namaqualand; from coastline to the escarpment, from Clanwilliam northwards, crossing over the Orange River into the southern Namib. Distichous with rough, lorate, spotted leaves, from 50–200 mm tall. Simple inflorescence with large flowers, flowering November to April. Both varieties form dense clumps. *G. pillansii* var. *pillansii* (*G. neliana*): occurs from Clanwilliam to the Richtersveld. Larger than the northern variety. Var. *ernestii-ruschii* (*G. ernestii-ruschii*): First collected at Lorelei near the Orange River at least 100 km from the Namibian coastline, also present on coastal mountains of the Richtersveld. A smaller plant, leaves less than 70 mm long, and later flowering, from December to April.

2.2 Series *Gasteria* Duv.

Perianth 12–22 mm, perianth base usually markedly globose, or globose-elliptic (6 species)

G. disticha (L.) Haw. (*G. angustifolia*, *G. nigricans*, *G. mollis*, *G. conspurcata*, *G. obtusifolia*): Southern Great Karoo from Beaufort West eastwards; in the Koo and Breede River valleys, nearly always in the shade of karoo shrubs. A medium-sized gasteria up to 180 mm, sometimes taller, forming clusters. The lorate, distichous, rough-skinned leaves with obtuse apiculate ends closely resemble *G. pillansii* of Namaqualand, but the leaves often undulate, and the flowers (perianth 12–20 mm) are smaller. The inflorescence is simple, or side-branched, up to 900 mm tall, the base of the perianth globose-elliptic or narrow-elliptic. Flowering mainly in the spring (September).

G. brachyphylla (Salm-Dyck) Van Jaarsveld: Widely distributed in the Little Karoo south of the Swartberg and northwards to Willowmore. The varieties are distinguished by length and apex of the distichous leaves. Var. *brachyphylla* (*G. angustianum*, *G. triebneriana*, *G. joubertii*, *G. vlaakensis*): forming small groups; leaves densely spotted, dark green with an acute apex, up to 230 mm long. Flowers small, globose to globose-elliptic, flowering from September to October. The smooth shiny

leaves distinguish it from *G. disticha*. Var. *bayeri* occurs in the Little Karoo, near Ladismith and Calitzdorp. A small variant, leaves only 15-50 mm long, with truncated leaf-ends. The inflorescence (280 mm) and the flowers (perianth 18 mm) large for such a small plant. Flowers from October to February.

G. bicolor Haw. [colour p. 256] (*G. maculata*, *G. picta*, *G. retata*, *G. variolosa*, *G. colubrina*, *G. marmorata*, *G. planifolia*, *G. spiralis*, *G. zeyheri*, *G. caespitosa*, *G. chamaegigas*, *G. herreana*, *G. longiana*, *G. longibracteata*, *G. salmdyckiana*, *G. bififormis*, *G. kirsteana*, *G. multiplex*): This large synonymy is now represented by the typical var. *bicolor*. The distribution is in the Eastern Cape from Humansdorp eastwards, and northwards to Pearston, in a wide range of habitat. Up to 500 mm tall, it has a leafy stem, sometimes twisted, the lorate or linear, smooth, spotted leaves are distichous or spiralled. Leaves are up to 220 mm long, keeled or without a keel, with foliate stem up to 200 mm. The inflorescence simple or paniculate (1.5 m), the perianth 12-20 mm long, the flowers markedly globose, flowering throughout the year, but mostly in spring. Var. *liliputana* (*G. liliputana*) occurs from the Kap River mountains (Grahamstown) to the eastern Suurberg in the Alice's Dale district. A tiny, mat-forming variety, the leaves up to 100 mm long, usually narrowly lorate, dark green, white-spotted and glossy. Inflorescence simple, perianth 12-15 mm, flowering July to November. Somewhat variable, but easily recognised, var. *liliputana* is a world favourite with the pot plant collector.

G. baylissiana Rauh [colour p. 256]: Oudekraal, on the northern aspect of the Suurberg range in the Eastern Cape. A dwarf species up to 40 mm tall, it suckers from the base forming dense clusters of small plants with distichous leaves. It is distinguished by the pearly nature of the tubercles on both leaf surfaces. It is allied to very similar forms on the Suurberg which have smooth leaves. Inflorescence simple, up to 350 mm, the shell-pink shiny flowers markedly globose and the perianth 15 mm long. Flowering September to October.

G. glomerata Van Jaarsveld [colour p. 256]: Kouga Dam, near Patensie in the Eastern Cape, on vertical

south-facing cliffs. A miniature (15-40 mm) which forms dense compact mounds. This tightly packed character is soon lost in cultivation when the plants tend to 'grow out'. Leaves distichous, shortly lorate, ending bluntly with a short sharp point. Both leaf surfaces are glaucous, unspotted (most unusual) and finely tuberculate. The flowers are markedly globose and relatively large (perianth 20-25 mm) for so small a plant. Flowering in September.

G. rawlinsonii Oberm. [colour p. 256]: Southern Cape, Baviaanskloof. The only *Gasteria* to have long leafy stems, these usually pendulous over rock faces, reaching a length of 1 m or longer, and branching from the base, bearing distichous (or spiral) leaves (80 mm long, 20 mm wide) along their entire length. Leaf margins have wide-spaced small teeth, leaf surface is dull green and faintly marked. The leaf does not reproduce vegetatively as in other *Gasterias* (Van Jaarsveld 1994) and this is probably a primitive feature. The inflated base of the flower is waxy salmon-pink. Flowering from August to October.



Gasteria rawlinsonii from the drawing by Marguerite Scott.

Note: The preceding account outlines with a little latitude the Van Jaarsveld revision which reduces the nomenclature of *Gasteria* and provides its geographical distribution, but one has only to look at the wide synonymy to realise that there are many intermediates in this variable genus. Also, some 49 trivial names are given to natural veld forms which are placed under the heading 'cultivars' in *Gasterias of South Africa* (Van Jaarsveld 1994). While 'Bowie' which has been in European collections since 1825 is quite rightly a cultivar, 'Pearston' collected in the Suurberg range, is not. It is well to remember the definition of a cultivar: 'A variety of plant produced from a natural species and maintained by cultivation' (Collins Concise English Dictionary 1993). Using trivial names for natural veld forms of *Gasteria* can only further confuse its nomenclature.

Astroloba Uitewaal

The first name given to this break-away group from the genus *Aloe* was *Apicra*, meaning 'non-bitter', an allusion to the absence of the bitter sap present in aloe leaves. In 1947 the genus was re-named *Astroloba* ('star-like petals') by Uitewaal. Within the context of the family which is now called Aloaceae, Haworth called *astrolobas* 'the most rigid plants of all, always tending to be caulescent'. *Astroloba* is close to *Haworthia*, and yet, habit-wise, the two genera can be seen to be different. Their flowers are distinctly different: in *Astroloba* the flower is regular, in which the short free perianth tips open out like a small star; in *Haworthia* the perianth is irregular and nearly always bilabiate.

Astroloba is usually multi-stemmed from ground level, the stems completely covered by hard, spiralled, stiff, pungent leaves. The lower or abaxial side of the leaf is tuberculate or smooth, spreading or erect. The inflorescence is an axillary raceme, the peduncle simple or branched. The flowers are pedicellate, with a straight tubular perianth about 10 mm long.

The genus is presently under revision. It was revised in an unpublished M.Sc. thesis in 1965 by Mrs P. Roberts-Reinecke (University of Cape Town). Only four species are given in *List of SA Succ. Plts.* (1997); according to the latter publication and the Roberts-Reinecke thesis there are seven species (three unpublished new species and two new subspecies). In 1998 Meyer and Smith in *Bothalia* 28(1) trace the changing nomenclature of the species known since 1947 as *Astroloba aspera* (Haw.) Uitewaal. They conclude that this species lacks a legitimate name and propose a new name, *Astroloba corrugata*. This action was pre-empted by both Roberts-Reinecke (1965) who proposed the name *A. rugosa*, and Groen (1987) who proposed the name *A. muricata*; neither of these two names were validly published. In the same paper Meyer and Smith refer, by name only, to *A. congesta* (Salm-Dyck) Uitewaal, which Roberts-Reinecke allies to *A. foliolosa* in her unpublished thesis. A fully treated revision of this small genus is long overdue. The distribution of the genus lies entirely within the southern Cape Provinces.

A. spiralis (L.) Uitewaal [colour p. 256]: From the Little Karoo across to Graaff-Reinet in the eastern Great Karoo. Stems up to 200 mm high, the leaves grey to bluish-green, smooth, up to 30 mm long, pungent, erect (unlike *A. herrei* in which



Astroloba spiralis

the leaves tend to spread), obliquely keeled at the apex. The inflated perianth tube is transversely rugose (wrinkled).

A. herrei Uitewaal: Vicinity of Uniondale, and in the Great Karoo near Prince Albert and along the road to Klaarstroom. Stems up to 200 mm tall, densely leaved in five spirally arranged rows; young leaves bluish-green and waxy, becoming deep green and ending in sharply keeled brown tips, 25 mm long and marked with many dark green lines. This species is close to *A. spiralis* with which it shares the inflated perianth, but it has a smooth perianth, not rugose as in *A. spiralis*.

A. bullulata (Jacq.) Uitewaal [colour p. 257]: A very distinctive species which occurs in the Ceres and Sutherland districts, and from Laingsburg to Matjiesfontein in the Western Province. A neat, dark, compact species, stems about 60 mm tall, not freely branched from the base as in other species. Leaves deep olive-green, matt with polished margins, dark tubercles on the lower (outer) surface, keeled-marginate (in which the keel becomes a margin near the leaf-tip). A handsome species with attractive flowers.



Astroloba bullulata showing keeled-marginate leaf



Astroloba corrugata



Astroloba foliolosa

A. corrugata N.L. Meyer & G.F. Smith (*Aloe aspera*, *Apicra aspera*, *Haworthia aspera*, *Astroloba aspera*. The names *A. rugosa* and *A. muricata* were proposed but not validly published): Little Karoo from Montagu to Ladismith and Seven Weeks Poort, and south of the Langeberg from Worcester to Riversdale. Stems erect, solitary or clustered, 300-600 mm tall. Leaves spreading, 14-25 mm long, deltoid-ovate with pungent tips, light to dark green, leaf surface always tuberculate or asperous, tubercles well dispersed but tending towards longitudinal lines, with non-marginate leaf keel. Inflorescence up to 430 mm long, peduncle simple, raceme with 9-30 flowers on erect pedicels up to 9 mm long, flowers white to cream, tinged green or pink.

A. foliolosa (Willd.) Uitewaal [colour p. 257]: This species covers a wide range in Western and Eastern

Cape Provinces. In the west it is found from Laingsburg to Beaufort West and eastwards to Graaff-Reinet; it is present in the Little Karoo, and in the east from Albany towards Cradock. The distribution patterns may indicate the need for several sub-specific taxa as there is variance in dimension. The typical plants have slender, tall stems up to 300 mm, densely covered by roundish- triangular leaves which have a glossy sheen, smooth and sometimes with whitish margins. Plants in Albany and towards Cradock which have shorter stems with smooth, almost horizontal, dull-glossy leaves form part of the 'foliolosa' complex.

Poellnitzia Uitewaal

This handsome monotypic genus is caulescent and densely leaved in five distinct series, a habit entirely comparable with that of the *astrolobas*. However,

the long simple inflorescence carrying orange-red flowers reminiscent of *Aloe* resembles neither *Astroloba* nor *Haworthia*.

P. rubriflora (L.Bolus) Uitewaal [colour p. 257] (*Apicra rubriflora*, *Haworthia rubriflora*, *Aloe rubriflora*, *Apicra jacobseniana*): Endemic to the Robertson Karoo, growing in karoid succulent veld in the vicinity of McGregor, Bonnievale and Robertson. Low-growing, clustered habit, nearly always under bushes; stems up to 250 mm, densely leaved in 4-5 series, the hard leaves up to 40 mm long, tapering and sharp-tipped, waxy, bluish-green but turning brown in the sun. Inflorescence with a simple peduncle up to 550 mm long, the raceme horizontal, the flowers spirally arranged but twist into an erect secund position as in some aloes, pedicels 5 mm long, perianth narrow and about 25 mm long, orange-red, perianth tips dark and scarcely separated.



Astroloba inflorescence



Haworthia inflorescence

Haworthia Duval

In the early days of the Cape Colony, shortly before 1700, these plants were included in the genus *Aloe*. The name *Haworthia* was first used in 1809 by Henri Auguste Duval in honour of the English botanist, Adrian Hardy Haworth. It is certain that Duval could have had no idea that he had named a problematical genus which was to lead to a mass of largely inaccurate literature, the sifting of which still proceeds today. *Haworthias* (like *gasterias*) are variable in the field and no one separate plant should be described, as was frequently done by the early authors. An *Haworthia* species should be seen in the context of geographical distribution and field relationship with other species. Over 400 names, largely attributable to von Poellnitz, Haworth and G.G. Smith, have been used at infra-generic levels for the plants in this genus. For a long while, 20 sections contributed by eight authors were, and to some extent, still are, recognised. These sections were based on supposed vegetative differences and formed an artificial system in which closely related, geographically aligned plants often found themselves in separate sections. As far as the numerous species descriptions were concerned, errors were made as to localities and there was an almost total lack of field investigation by overseas authors who worked mainly on information at second hand. In several established instances, the home town of the collector was recorded as the locality of the species, which was, in fact, many kilometres distant!

This extensive, doubtful nomenclature later created practical problems in the collection of named seed by the Karoo Botanic Garden at Worcester, south-western Cape, for dispersal to members of the Botanical Society of South Africa. In the late 1960s, M.B. Bayer, assisted by F.J. Stayner who was then Curator of the Karoo Garden, commenced field investigation of *Haworthia* on a large and determined scale. The detailed records of G.G. Smith were obtained and the help enlisted of G.L. Payne who had collected much of von Poellnitz's material, and who was able to correct locality errors and point out type localities. In 1976 Bayer's guide to the species, '*Haworthia Handbook*' was published. The culmination of seven years of field work, it was strongly influenced by geographic location and relationships between species. It reduced the genus to 67 species and some 41 infra-specific taxa. In 1982 Bayer's *The New Haworthia Handbook* appeared in which 68 species were recognised. In both manuals keys to all taxa were presented. In Bayer's 1999 revision (*Ha-*

worthia Revisited) the species are arranged alphabetically under three subgenera. The description of the species which follows relies on Bayer's latest findings. In the following account related species are placed together in an attempt to facilitate identification and comparison. *Haworthia* is restricted almost completely to the southern regions of South Africa; there are outliers in Mozambique, Eastern Transvaal, Swaziland and KwaZulu-Natal, as well as a low profile in the Free State and Namibia.

Haworthia subgen. Haworthia (42 species)

Perianth at base triangular or rounded-triangular, style upcurved, tube obclavate.

H. herbacea (Mill.) Stearn [colour p. 257]: Worcester area extending to east of McGregor and south to Villiersdorp in the Western Cape. Solitary or clustering, the rosette is up to 80 mm across, composed of up to 80 leaves, greenish-yellow, erect, incurved, scabrid, margins and keel spinescent, leaf surface reticulated and translucent. Flowers are large, beige with pinkish tips, appearing in the spring. Several varieties have been set up, one of them var. *paynei* is a smaller plant with a pink and white flower at McGregor. The species is closely allied to *H. reticulata*.

H. reticulata Haw. [colour p. 257]: Extends along the Breede River from Worcester to Bonnievale. It is a variable species, closely related to *H. herbacea* and intergrades with it. It is slightly more robust than its ally: the rosette measures 30-80 mm, consisting of about 40 leaves with a maximum length of 60 mm. The leaves are green, pinkish-mauve in the sun, markedly reticulate, the margins and keel are lightly denticulate or smooth, the flowers pinkish-white to pink. It is a smoother, more turgid clump-forming species than *H. herbacea*. Both species flower in the spring.

H. pubescens Bayer: A small haworthia with limited distribution on sandstone south-east of Worcester in the Western Cape. The stemless rosette has the habit of *H. herbacea* and flowers later, in summer. The rosette is up to 40 mm across, with 20-35 incurved leaves, opaque greyish-green, covered with short fleshy hairs particularly on the abaxial (outer) surface. Flowers 10-15, white with pinkish veins. A form further south which is less pubescent is now known as var. *livida*.



Haworthia maculata, near Worcester

H. maculata (V. Poelln.) Bayer: This species has been traced to Brandvlei just south of Worcester where it clusters among quartz rocks. The rosette is up to 60 mm across, the leaves many, erectly spreading, purplish-green, reticulate with transparent patches, with short spines on margins and keel. It is similar to *H. herbacea*, but is a more turgid plant; it flowers from October to November, the flowers similar to those of *H. herbacea* and *H. reticulata*. It also occurs in the sandstone mountains north of Worcester.

H. vlokii Bayer: Western Cape: Meiringspoort, Swartberg mountains, preferring the upper levels. A new small species up to 60 mm across, clustering, leaves sub-erect, apiculate, leaf-tips incurving, surface opaque with white dots above and below, one (or more) sharp, spinescent keels, the margins also spiny towards the apex. The flowers white and brownish-pink, with perianth segments regular. Bayer allies it to *H. maculata* from the Langeberg further west; both species flower in November, and both have a more regular stellate flower.

H. turgida Haw. This interesting species has the widest distribution of the south-western Cape haworthias. It extends from Little Brak along the coastal area westwards to Bredasdorp and occurs

on high mountains in the Langeberg range, following the river valleys to the coastline. It is a small species up to about 30 mm across, forming dense clusters; the leaves 20-40 are thick and turgid, mottled, yellowish-green to pink, spinescent on margins and keel. The leaf-ends may be slightly retused but the clusters do not withdraw into the ground. Flowers narrow, brownish-white.

H. heidelbergensis Smith: A small species extending from Heidelberg westwards to Bonnievale and Bredasdorp in the Western Cape. It appears in colonies (not necessarily in clusters) in thick moss. The leaves, dark green with reddish tints, are erect to recurved, the leaf-end area translucent, very acuminate and produced into an awned tip, leaf margins and keel dentate.

H. serrata Bayer: A distinct species which occurs between the Breede River and Duivenhoks River south-west of Heidelberg in the Western Cape. The neat rosette of narrow, evenly-toothed leaves is a fresh-green colour spreading erect, up to 70 mm across, and reminiscent of *H. herbacea*. It produces unexpectedly large white flowers.

So far, the species described are of the '*herbacea*' type, with firm greenish, variably turgid, translucent and spinescent leaves, and with a suggestion of a marked or semi-retused leaf-end area in two of them. In the following ten species the triangular leaf-end is markedly retused and this specific character is associated with the withdrawal of the plant body underground so that in most cases, only the leaf-ends are visible. This 'buried habit', found also in *Lithops*, is just one evolutionary gambit to combat drought, heat and predation, and, like many morphological characters it is not present, or absent, but is there by degree. When a species is delimited because it has triangular leaf-ends at the centre of its dispersal it should not be surprising to find that the retused nature weakens at the edge of its distribution where, under other influences, the leaf straightens out into an erect position and the retused condition is lost.

H. magnifica V. Poell. [colour p. 257]: A variable species in the Western Cape which extends from Heidelberg to Riversdale, and north to Barrydale. Rosette up to 80 mm across. Leaves have triangular retused leaf-ends at ground level, dark green to purplish, scabrid to spinescent margins, surface striated, slightly translucent, raised tuberculate. In-

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area south of Kleinpoort on the Springbokvlakte in the Eastern Cape, and is the most eastern record of the retused species. It is solitary, large (up to 100 mm across) with 8-12 distinctive, turgid, rounded, translucent leaf-end areas, up to 12 striae fading to transparency as they cross the swollen convex area. In the field grit sticks to the leaf-end surface. Flowers white with brown venation.

H. bruynsii Bayer: South-east of Steytlerville in the Eastern Cape. A small solitary species, the rosette up to 60 mm across, the leaf-end areas bluntly triangled, flattened, retused, opaque, slightly scabrid with raised tubercles. The inflorescence is simple, sparsely flowered; the flowers are described as being aligned with those of the subgen. *Hexangulares*.

Although not retused, there are two other *Haworthia* taxa which withdraw the plant body below ground, showing only truncated leaf-ends at soil level. They both occur in the Little Karoo:

H. truncata Schönl. [colour p. 258]: A fairly wide distribution from south-west of Calitzdorp to De Rust east of Oudtshoorn, in the Little Karoo. It exhibits very regular distichous arrangement of the truncated leaf-ends at soil level. The leaf-end is narrowly oblong, greyish-green with paler veining, translucent and scabrous with small tubercles. In cultivation the plants generally receive too much water and tend to 'hump' above soil level. The origin of the truncation is quite different to that of the bending of the leaf-end in the retused haworthias. The other taxon is the well known *H. maughanii* which in the Bayer 1999 revision becomes var. *maughanii* under *H. truncata*. It occupies a very localised area about 800 m wide near Calitzdorp. There is a high density of other succulents (except *H. truncata*) in this patch. All the var. *maughanii* specimens in this population exhibit the two characters which defined it in the first place: rosulate leaves and rounded leaf-ends which are translucent to opaque, marked or unmarked, glaucous and scabrid. Just 1½ km away is a separate population of intermediates showing a mix of the 'truncata' and 'maughanii' characters; this community has the appearance of a hybrid swarm. Almost the whole of this part of the Gamka valley has been flattened (virtually to pebbles and sand) by many ostrich camps and the species distribution has been totally disrupted. The illegal sale of these plants from the veld to collectors and nurseries is common knowl-



Haworthia truncata var. *maughanii*

edge and worsens the position. Whatever its status, the rosulate population faces a bleak future.

H. arachnoidea (L.) Duval [colour p. 258]: The species now includes four new combinations and two new varieties, and therefore presents a formidable range from the Richtersveld in Namaqualand through Calvinia and Sutherland districts across most of the central Western Cape (karoo) and ending at Coega in the Eastern Cape. The rounded rosette is 40-100 mm across, solitary or clustering. Up to 80 leaves, incurving, green, not translucent, flat and drying brown at tips; margins and keel markedly setose (with bristles). Inflorescence up to 300 mm, flowers white. The typical variety is present in the Worcester-Robertson Karoo, embedded in moss on southern slopes; it is dark green with marginal setae. Var. *aranea* (*H. aranea*) is small and softly setaceous; it is found from Oudtshoorn to Uniondale. Var. *namaquensis* is pale green, moderately setose and withdrawn into the soil cover (Richtersveld to Ceres Karoo). Var. *scabrispina* which is stiffly bristled and var. *setata* (*H. setata*) which is softer, are both karoo forms. Var. *xiphophylla* (*H. xiphophylla*) is bright green, an Eastern Cape element occurring at Uitenhage and Coega. Var. *nigricans* takes *H. unicolor* var. *venteri* into synonymy.

H. decipiens V. Poelln.: There are some records of

this species in the Great Karoo (Prince Albert, Merweville) but it is more prevalent in the Eastern Cape. It would seem at first sight to be similar to *H. arachnoidea*. In the west the leaves are broad, flat, yellowish-green with sparse marginal teeth which are broad-based. Eastwards, towards Jansenville the leaves are bluish-green and have some translucence, features which characterise *H. bolusii*, particularly its var. *blackbeardiana* which is wide-spread in the Eastern Cape.

H. bolusii Baker: Widespread inland distribution in the Eastern Cape, with some records in the Richmond and Hanover areas. With the plant habit of *H. arachnoidea* it differs in being translucent bluish-green. The rosette varies from 40-150 mm across. In the typical variety the setae are so fine that the plant forms a small white ball. Var. *blackbeardiana* which extends from Britstown south-eastwards to King William's Town is a much larger plant and again it reminds one of the 'arachnoidea-deciciens' habit, remembering that *H. deciciens* var. *cyanea* is bluish-green.

H. semiviva (V. Poelln.) Bayer: Some of the highest Karoo temperatures are recorded in the Frasersburg, Sutherland and Williston districts where *H. semiviva* occurs. It is not surprising that this species which has the incurved, setaceous form of the 'arachnoidea-deciciens' type, has developed the protective 'die back' leaf character seen also in the allied but non-setose *H. lockwoodii* near Laingsburg. *H. semiviva* is nearly always a solitary plant.

H. lockwoodii Archibald [colour p. 259]: South of Laingsburg in the Western Cape. Rosette up to 100 mm across consisting of many broad incurved leaves, pale green and translucent with smooth margins. The leaves are non-keeled and without setae. In the dry season the leaves desiccate to a white papery cover, the plants being well hidden in habitat. Bayer (1999) confirms that this species is allied with *H. deciciens*.

H. mucronata Haw. [colour p. 259] (*H. habdomadis*, *H. unicolor* var. *unicolor*, *H. unicolor* var. *helmae*, *H. rycroftiana*): *H. mucronata* is now applied to plants in the Little Karoo which have soft, incurved, somewhat transparent leaves, the margins and keel usually setaceous. Var. *habdomadis* which occurs at Seven Weeks Poort near Ladismith has setaceous leaves. The large specimens north of Ladismith (up to 80 mm across, 40 mm tall) with

turgid, glabrous or lightly setose leaves with long tips, the outer leaves desiccating, are var. *inconfluent*. Var. *morrisiae* which was found by the author's mother, Mrs F.N. Morris, at Calitzdorp, is distinguished by its smaller, smooth, withdrawn habit and bright green colour. *H. rycroftiana* of Gouritz River valley is transferred to varietal status under this species.

H. nortieri Smith [colour p. 259]: Extends from Namaqualand sandveld (Groen River) to the Cedarberg and to west of Laingsburg. A small species (30-50 mm across), soft-leaved with translucent spots, denticulate on margins and keel, pale to purplish-green. Flowers variable: the typical variety may have yellow-throated flowers, while another element has globose, short flowers. The variety near Laingsburg is setose like *H. arachnoidea* and lacks translucent spots.

H. marumiana Uitew. (*H. archeri*, *H. batesiana*): The typical clump-forming variety has a mainly eastern distribution in hot dry Karoo from roughly Beaufort West to Sterkstroom. The rosette is up to 70 mm across, leaves fairly soft, erect to spreading, incurving, purplish-green, opaque with patterned reticulation, the leaf-tip with a thread-like awn. Var. *batesiana* is a small, smooth, bright green form with non-setose but awned leaves from Graaff-Reinet. Var. *archeri* is a small, brownish-green, setaceous, non-proliferating element with an entirely Western Cape Karoo distribution.

H. aristata Haw.: Eastern Cape. Haworth's species was not used in the *Haworthia Handbooks* (1976 and 1982). In Bayer's 1999 revision of the genus, *H. aristata* is reinstated to cover a small species growing just north of Port Elizabeth. The rosette is up to 60 mm across, slowly clustering, leaves erect, incurving and awned, dark green, margins and keel spinulose, with faint translucence and marking.

H. cooperi Baker [colour p. 259] (*H. joeyae*, *H. venusta*, *H. gordoniana*): Eastern Cape. The rosette which is usually withdrawn in the soil is 35-120 mm across, the leaves thick, turgid, often stubby and ending abruptly, or acuminate, bluish-green, somewhat translucent with marks radiating from the awned leaf-tip. Margins and keel setose or smooth. Dense clusters often form. Seven varieties are recognised (Bayer 1999), but only one of them, var. *gordoniana*, has a separate location west of Port Elizabeth (Hankey) while the main distribution

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across), the leaves opaque and dark green, curved and spreading, the leaf twisting at the upper end with a flattened rounded tip. Margins scabrid to denticulate. The typical var. at Heidelberg is uncommon and glabrous, unlike var. *dentata* at Riversdale which has spinescent margins. Plants collected south of Swellendam have pointed recurving leaves. Bayer mentions plants at Great Brak which may be *H. floribunda*.

H. parksiana V. Poelln.: Western Cape: Great Brak. Many superlatives can be applied to this species: the smallest, the darkest (almost black), the rarest of the genus. Unfortunately its locality has been taken over by town development. It would present an excellent case for re-introduction of specimens of known origin into the wild in the Great Brak-Little Brak area, or even a small reserve of its own. The neat tiny rosette consists of a perfect circle of sharply recurved pointed leaves, a cryptic species in the veld. Its nearest relative is probably *H. floribunda*.

H. zantneriana V. Poelln.: Eastern Cape, at Campherpoort, south of Klipplaat. Found clustering in rock crevices on southern slopes. The rosette is up to 60 mm across, the leaves soft, pale green with white marks arranged along the length of the leaf. The leaf is broad based, tapering evenly to a sharp point, the margins clear and smooth.

H. wittebergensis Barker: Western Karoo. First collected on the northern face of the Witteberg at 1280 m in the Laingsburg district, it has a narrow distribution. A very inconspicuous plant which tufts and emerges from between cracks in the rocks. It has coriaceous, long, very narrow leaves similar to those of *H. blackburniae* of Calitzdorp. The leaves are up to 100 mm long, acute, erect, dark greyish-green, dilated to 14 mm at base, distinctly keeled, with margins and keel dentate. The leaf-tips are necrotic, falling off and limiting the height of the plant.

H. pulchella Bayer: Western Cape. Just west of the *H. wittebergensis* locality, *H. pulchella* occurs in the vicinity of Touws River. The typical var. is usually solitary, severely incurved. This is a small dark green, rounded species with white spines on margins and keels. The leaves are coriaceous and patterned. Var. *globifera* refers to a population on the southern side of the Anysberg where the plants are larger, clustering and globose.

H. blackburniae Barker [colour p. 260] (*H. graminifolia*): Western Cape: Little Karoo. Its discovery in 1935 was an important one, because while the flowers were typical of *Haworthia*, the linear leaves, which may exceed 300 mm, were unknown in the genus. *H. graminifolia*, known only from Schoemanspoort east of Oudtshoorn, is now treated as *H. blackburniae* var. *graminifolia* (Bayer 1999). Var. *derustensis* is a vigorous form with longer leaves (450 mm) found at De Rust, also near Oudtshoorn. This unusual species has channelled, greenish, denticulate leaves, fibrous leaf bases and fusiform roots. It is closely associated with *H. wittebergensis* which has similar habit.

Haworthia subgen. **Hexangulares** (15 species)

Perianth at base hexangular, style straight, perianth narrows to junction with pedicel (stipitate).

An interesting aspect of this subgenus is the comparative ease of identification of most of its members, stemming from discontinuity in variation. Most species (69%) occur in the Eastern Cape. It is in contrast to the position in the Western Cape, home to 74% of subgen. *Haworthia*, where frequent instances of continuous variation make species delimitation difficult. Furthermore, several constant characters typify the *Hexangulares*: hard, scabrid and/or tuberculated leaves, sometimes a definite twist in the rosette, and, in the stemmed species, the leaves close-packed in spiral or trifarious arrangement. Setae and spines which protect soft, fleshy plants are absent here. The 'odd man out' is *H. bruynsii* which belongs with the retused haworthias but has floral characters which match those of *Hexangulares*; this appears to be an isolated problem.

Stemless species

H. scabra Haw. [colour p. 260] (*H. starkiana*): Western Cape, from Ladismith in the Little Karoo to east of Uniondale. Dark, stemless clustering plants with thickish leaves, the rosette displaying a characteristic twist, surfaces smooth or scabrid, or tubercled; from 30-100 mm tall. The typical var. is a small, blackish-green, tubercled, mostly twisted plant. Var. *morrisiae* is scabrid, twisted, smoother than the typical var., clustering among rocks in the Schoemanspoort, Rust-en-vrede area in the Cango

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fairly broad at base they taper to a blunt point, surfaces scabrid and tuberculate. Var. *lavrani* is the smaller form with recurved leaves which occurs westwards near Steytleville.

H. glabrata (Salm-Dyck) Baker: Eastern Cape, Bashee River area. If anyone was destined to find this long lost species it would have to be Peter Bruyns who tackles kloof, mountain and valley in a fearless and determined manner. And so it was that he recently rediscovered *H. glabrata*, which is not smooth but scabrid and finely tuberculate. It is stemless, green in colour, the leaves shortly lanceolate with die-back tips and broad at base. It proliferates readily into clumps.

H. limifolia Marl.: Described by Marloth in 1908, this striking species was first recorded from west of Delagoa Bay and occurs in Swaziland, Kwazulu-Natal and the Eastern Transvaal. The rosette is 50-70 mm across, dark (or sometimes lighter) green, opaque, leaves usually spreading, channelled on upper surface with elevated margins, moving quickly from a broad base to a sharp, narrow point. The leaves are scabrid with tubercles which are raised in ridges on both leaf surfaces, or dispersed. Var. *gigantea* is very large with small dispersed tubercles, occurring in northern KwaZulu-Natal. Var. *ubomboensis* is a smooth-surfaced, light green element which was found in the mountains near Barberton; it has not been re-collected and is apparently rare.

H. koelmaniorum Oberm. & Hardy (*H. mcMurtryi*): Very localised distribution at Groblersdal in the Eastern Transvaal. Dark brownish-green, rosette up to 70 mm across. The leaves are opaque, recurved, scabrid and tuberculate, margins and keel spinulose (unique for *Hexangulares*). Var. *mcMurtryi* is smaller with leaves which appear to be windowed. The discovery of this species in 1963 by Marius Koelman was important because *Haworthia* is largely a Cape genus and unexpected so far north.

Stemmed species

H. coarctata Haw.: Eastern Cape; concentrated in the Grahamstown area but extending to Addo in the west and near the Fish River in the east. If one looks at the general form of this common species, it becomes obvious that not only is it instantly recog-



Haworthia limifolia

nisable but it is also one of the least variable of the haworthias. It has a leafy stem and forms dense clusters, adapting well to cultivation. It has less, more open spirals of fatter leaves than *H. reinwardtii* in which the leaves are densely packed, clasping, and thin in transection. If a straight line is drawn across the *H. reinwardtii* stem and the leaves that lie opposite the line counted, the result is often 10. If repeated with *H. coarctata* the answer is often 5. Both species have white tubercles on the outer (abaxial) leaf surface, usually smaller and diffused in *H. coarctata*, more prominent and often in cross bands in *H. reinwardtii*. Typical *H. coarctata* occurs frequently on the farms around Grahamstown, usually on rocky terrain, not on open grasslands. Superficial variation does occur: A smooth form, forma *greenii* after G.H. Green (no allusion to colour), occurs in Howieson's Poort. Var. *adelaidensis* which was originally collected at Grahamstown (not Adelaide) is a smaller element. A variety of some substance is the surprising var. *tenuis*, the stem of which is half the diameter of var. *coarctata*, and reaches lengths of over 400 mm at Harvestvale on the Bushmans River.

H. reinwardtii (Salm-Dyck) Haw. [colour p. 260]: Eastern Cape. More prevalent from the Fish River eastwards to south of East London, but does extend west as far as the Kowie River, and inland to Peddie. Once again, if one looks at the general form of the species, one cannot mistake its identity. The stem and leaf characters which distinguish it from *H. coarctata* are discussed under that species. *H. reinwardtii* has more striking tuberculation than *H. coarctata*. The tubercles may form prominent

transverse ridges, lie in longitudinal rows or are discrete. Typically, the species is brownish-green, but under certain conditions of habitat the colour may be olive-green, orange or rust-red. A smaller form is reported from habitats shared by fynbos, which indicates poor soil. It is a matter of opinion whether these interesting variations warrant infra-specific recognition.

H. glauca Baker: Eastern Cape. From north of Willowmore eastwards to Kirkwood, with the Suurberg the eastern limit. The stems vary from short in the Suurberg mountains to longer in the adjacent Klein Winterhoek mountains and westwards. The glaucous, sharp-pointed leaves spiral closely up the stem, varying from smooth and incurved in the Suurberg to tuberculate and open in localities further west. The presence of tubercles distinguishes var. *herrei*. However, around Kirkwood the plants show smooth and tuberculate leaves, and Bayer describes plants at Campherpoort as variable with regard to leaf shape, direction and surface, so the distinction between the two varieties is not very clear.

H. viscosa (L.) Haw. [colour p. 260]: Apart from a disjunct occurrence at Graaff-Reinet, this karoid species follows a punishing route from 25° longitude westwards north and south of the Baviaanskloof mountains, into the searing Great Karoo from Vondeling to Klaarstroom, south of the Swartberg range along the Little Karoo and north again to Laingsburg. One should look at the range of *H. nigra*, its close relative, to complete the picture. This shorter ally lies mainly to the north and east of *H. viscosa*, and misses out the Little Karoo completely. *H. viscosa* is a tall (up to 300 mm) stemmed plant, a small sculptured masterpiece of closely packed, hard, scabrid leaves arranged in three ranks; the leaves with pungent tips are dark green in shade, becoming grey or even red or orange in sun, often with some members of the cluster bleached to whitened husks. A very settled, probably very old species, certainly one of the originals.

H. nigra (Haw.) Baker: The typical form of *H. nigra* is predominantly Eastern Cape and covers a good deal of it, particularly those areas north and east of *H. viscosa*, at Middelburg, Queenstown, Molteno, Fort Beaufort, Grahamstown and East London. It is usually stemmed, up to 100 mm tall but often shorter; it may form several stems bearing blackish-green, densely tuberculate leaves which are arranged spirally or in three upright ranks with a pungent

straight or recurved leaf-tip. Var. *diversifolia* is similar with greyish-green colour, tightly trifarious, and has a western-central distribution from Merweville to Beaufort West and Willowmore.

H. pungens Bayer: Eastern Cape. This new species centres on collections from two localities in the Langkloof, both on the southern aspect of the Kougaberge. The plant is described as being similar to *H. viscosa*. The leaves are spreading, smooth, sharply pointed and arranged in 3 to 5 ranks on the stems, which form clumps. The flower is typical of subgen. *Hexangulares*.

H. venosa (Lam.) Haw. [colour p. 260] (*H. woolleyi*): Widely dispersed in South Africa and present in southern Namibia. Stemless, but may form mats by means of stolons, and stemmed in one subspecies. The stemless rosette is up to 30 mm tall, leaves spreading, recurved, scabrid-tuberculate below, smooth and reticulate above, leaf-tip pungent. Subsp. *venosa* occurs south of Swellendam in the Breede River valley, its lower leaf surface and margins tuberculate. Subsp. *tessellata* is widespread in South Africa, mainly central and across the Northern Cape into Namibia. The tessellate veining is more marked, the clear patches very translucent especially when wet; a favourite of the collectors. The stemless parent plant produces underground stolons which extend for up to 140 mm, resulting in a mat of plants. Subsp. *granulata* is usually tall-stemmed and clustering, with scabrous leaves loosely spiralled. It occurs in the Western Cape from Sutherland to Touws River and along the western edge of the



Haworthia nigra

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Glossary

Abaxial: away from the axis.
Acuminate: tapering to a point.
Acute: sharply pointed but not drawn out.
Adaxial: towards the axis.
Adpressed: closely pressed together but not joined.
Adventitious: applied to roots, those which do not arise from the radicle but from another part of the plant, usually the stem.
Aestivation: the manner in which the parts of a flower are folded before opening.
Allopatric: geographically separated.
Amplexicaul: stem-clasping.
Ampulliform: flask-shaped.
Annual: a plant which completes its life cycle within a year.
Annulus: in some *Stapelieae*, the portion of the corolla which forms a fleshy, raised ring.
Anther: the part of the stamen which contains the pollen.
Apiculate: tipped with an apiculus, a short, sharp point.
Apomorphy: derived character.
Apomixis (apomictic): omission of sexual fusion in reproduction.
Aristate: awned.
Asperous: rough with short hairs or points.
Asperulous: slightly rough.
Attenuate: tapered.
Auriculate: with an ear-like appendage.
Autapomorphy: derived character unique to one taxon.
Awn: a stiff, bristly process.
Axil: the angle between the axis (stem or branch) and the part arising from it (leaf or bract).
Axile: belonging to the axis, as in axile placentation.
Axillary: growing in an axil.

Biennial: a plant which completes its full life-cycle in two years.
Bifid: divided into two parts.
Bicampanulate: when a second bell-shape is formed by the corolla.
Bilabiate: having two lips.
Bisexual: having stamens and pistil in the same flower.
Bract: a modified leaf associated with the flowering part of the plant.
Bracteate: possessing bracts.
Bracteole: a small bract.

Caducous: falling early, leaves or flowers.
Caespitose: growing in tufts or patches.
Campanulate: bell-shaped, as in some corollas.

Canaliculate: channelled.
Candelabriform: with the shape of a tall branched candlestick.
Capitate: applied to an inflorescence in which the flowers form a head.
Capitulum: a small head (of flowers).
Capsule: a dry, dehiscent fruit.
Carpel: a simple pistil consisting of ovary, style and stigma, or element of a compound pistil.
Cartilaginous: sinewy, tough (in respect of leaf margins).
Carunculate: possessing small warts or protuberances.
Caudex: the stem of a plant.
Cell: in the mesems, a chamber or loculus of the ovary.
Ciliate: fringed with hairs, as on the margin of the corolla lobes in some *Stapelieae*.
Clavate: club-shaped, thickened towards the top.
Cleistogamous: applied to a flower in which fertilisation occurs without the flower opening.
Conic-capitate: a cone-shaped head of flowers.
Connivent: converging.
Cordate: heart-shaped.
Coriaceous: leathery.
Corona: in the *Stapelieae*, a crown-like portion of the staminal column, usually with inner and outer lobes.
Crenate: notched or scalloped.
Crisped: with curled or twisted edge.
Cultivar: a plant derived from horticultural practices, as distinguished from a natural plant in the wild.
Cultigen: a cultivated plant of uncertain origin.
Cuneate: wedge-shaped.
Cyathium: the inflorescence of *Euphorbia* (plural: cyathia).
Cylindric-acuminate: elongated and tapering to a point.
Cyme: an inflorescence in which the lateral axes grow more strongly than the main axis.

Deciduous: falling in season.
Decumbent: lying down with the apex up-turned.
Decussate: opposite in pairs set at right angles to each other.
Deflexed: bent abruptly downwards.
Dehisce: to split open when ripe, as in a capsule.
Deltoid: triangular.
Dentate: toothed.
Denticle: a small tooth.
Denticulate: minutely toothed.
Dichasium: a two-parted or two-ranked cyme.
Dichotomous: forked.
Dimorphic: two forms.
Diocious: male and female flowers on separate plants.

Distal: far from the point of attachment.
Distichous: arranged in two vertical ranks.
Diurnal: occurring in the day-time.
Divaricate: widely divergent.
Dorsiventral: upper and lower surfaces are distinguishable.

Elliptic: broadest in the middle, with both ends slightly acute.
Endemic: confined to a particular area.
Entire: with an untoothed and unlobed margin.
Exserted: protruded beyond.
Exsiccata: a collection or set of dried specimens, usually labelled.
Extra-floral: outside the flower.

Falcate: sickle-shaped.
Fascicle: a cluster or bundle of flowers.
Filament: the stalk of an anther.
Filiform: thread-shaped.
Free central: the attachment of ovules to an outgrowth arising from the base of the ovary.
Fusiform: thick, but tapering at both ends.
Fynbos: narrow-leaved vegetation dominated by Proteaceae, Ericaceae and Restionaceae on poor, sandstone-derived soils.

Geophyte: a plant which stores food underground and has subterranean buds which form aerial (seasonal) growth.
Glabrous: hairless, without pubescence.
Glabrescent: becoming glabrous.
Glaucous: bluish-green or grey; covered with a bloom.
Globose: nearly spherical.
Gynaecium: pistil or female part of the flower.
Gynostegium: staminal crown in the Stapeliaceae.

Habit: the general appearance of a plant.
Halophyte: a plant which grows in salty soil.
Heliotropic: growing towards sunlight.
Heterophyllous: having leaves of different forms.
Hirsute: hairy, with long distinct hairs.
Hispid: with strong hairs or bristles.
Hydathode: a water-secreting pore on the leaf.
Hygrochastic: applied to those plants in which the opening of the fruit (capsule) is caused by the absorption of water.
Hypanthium: an enlarged receptacle (under the calyx).

Iconotype: an illustration accompanying an original description when no type specimen was designated.
Idioblast: a single specialised cell present in otherwise uniform tissue.
Immaculate: unspotted.
Incumbent: resting upon.
Indehiscent: applied to fruits which remain closed at maturity.
Inflexed: turned abruptly inward.
Inflorescence: a special branch-system which bears the flowers.
Internode: the portion of stem between two nodes.
Involucre: a ring of bracts surrounding several to many flowers.

Keel: a longitudinal ridge, as at the back of a leaf.
Keeled-marginate: when the leaf-keel veers over to form a leaf-margin, as in some members of Aloiaceae.

Kloof: a deep narrow gorge or ravine.

Lacerate: torn.
Laciniate: cut into narrow lobes.
Lamina: the blade of a leaf.
Lanceolate: lance-shaped, tapering from a broad base to the apex.
Lax: loose, limp; not densely arranged.
Lectotype: a specimen chosen after the original description to be the type.
Ligulate: strap-shaped.
Linear: narrow with nearly parallel sides.
Lineate: striped, with parallel lines.
Locus: the cavity, cell or chamber of an ovary.
Lorate: strap-shaped, ligulate.

Maculate: spotted.
Marcescent: withering without falling off.
Mericaip: the partial fruit of a schizocarp.
Mesem: commonly used abbreviation of Mesembryanthemum; sometimes spelt 'mesemb'.
Mimicry: protective resemblance to the surroundings as in the stone-shaped species of Mesembryanthemaceae.
Monocarpic: only fruiting once.
Monochasial: a cyme in which the branching is continued by a single lateral branch.
Monophyletic: originally descended from one tribe, as opposed to polyphyletic, of multiple origin.
Monotypic: a genus consisting of one species.
Mucro (mucronate): a sharp terminal point.

Naviculate: boat-shaped.
Necrotic: applied to dead tissue.
Node: the part of the stem which gives rise to the leaf and bud.
Nomen nudum: the name of a taxon which has never been validated by a description.
Nothospecies: a hybrid.

Ob-: the prefix 'ob-' indicates inversion; for example ob-clavate means thickened at the base.
Obtuse: with a blunt or rounded tip.
Orbicular: flat with a circular outline; disc-like.
Ovary: the part of the pistil which contains the ovules.
Ovate: egg-shaped, broadest at the base; usually with reference to two dimensions.
Ovoid: egg-shaped, usually with reference to three dimensions.
Ovule: the young seed in the ovary.

Pachycaul: thick-stemmed.
Palmate: flat and lobed.
Panicle: a compound inflorescence in which the main axis bears lateral racemes or spikes.
Papilla: a small soft superficial gland or protuberance.
Papillate: having papillae.
Papillose: covered with papillae.
Parenchyma: undifferentiated plant tissue composed of more or less uniform cells.
Parietal: describes the attachment of the ovules to the wall of the ovary.
Pedicel: the stalk of a flower.
Peduncle: the axis from which the flower pedicel arises.

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The revised edition of *Succulent Flora of Southern Africa* deals with the six major groups of succulent plants occurring in southern Africa, and, as such, is still the only comprehensive work to do so. It covers the Mesembryanthemaceae, Portulacaceae, Crassulaceae, the succulent Euphorbiaceae, Stapeliaceae and Aloaceae, as well as a short chapter on *Adenium*, *Pachypodium* and *Adenia*.

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Southern Africa is the natural home of the most diverse and remarkable succulent flora in the world. This work is intended to contribute to the knowledge of these very specialised plants.

Doreen Court was born in the Little Karoo, educated in Grahamstown and spent nearly 30 years in Zimbabwe. In 1981 she obtained her M.Sc. at Rhodes University, where she lectured in plant systematics for eight years. She is a Research Associate of the Botany Department at Rhodes University and a Fellow of the Linnean Society. In 1996 she retired to Robertson which is at the centre of the Western Cape succulent karoo.

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